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PART I

AMERICAN WATER WORKS ASSOCIATION

In this issue

AMERICAN WATER WORKS ASSOCIATION
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Sowing

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A.W.W.A. 1951 ANNUAL CONFERENCE
Miami, Fla.
April 29—May 4

Reservation forms will be mailed to all members, and all reservations will be celared through the A.W.W.A. office. The hotels have agreed to accept no reservations for the 1951 Conference except as they are requested on the standard form provided by the A.W.W.A.

71st Annual Conference

January 16, 1951—New York Section Luncheon Meeting at Park-Sheraton Hotel, New York, N.Y. Secretary: R. K. Blanchard, Vice-Pres. & Engr., Neptune Meter Co., 50 West 50th St., New York 20, N.Y.

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Journal
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Winnipeg's Flood Emergency Organization

By William D. Hurst

A paper presented on Sept. 6, 1950, at the Minnesota Section Meeting, St. Paul, Minn., by William D. Hurst, City Engr. & Chairman of Commissioners, Greater Winnipeg Water Dist., Winnipeg, Man.

GREATER Winnipeg experienced the fourth largest recorded flood in its history when the Red River of the North overflowed its banks during the spring of 1950, with the water level reaching 30¼ ft. above normal ice level. Not since 1861, nine years before Manitoba became a province, and when Winnipeg had a population of under 200, had the Red River reached the flood stage that was recorded in 1950. Although only about one-sixth of the metropolitan area was covered with water, which had a maximum depth of about 12 ft., the effects of the flood extended over the entire city because of the flooding of the sewers.

Greater Winnipeg has undergone six major and five minor floods since 1826, a major flood being defined as one where the water level exceeds 24½ ft. above average ice level. The 1950 flood lasted from April 21 to June 10 and caused untold hardship and suffering, to say nothing of the dislocation and failure of essential services. The water supply, however, never failed. This was fortunate, considering the potentialities for the transmission of disease.

At midnight on May 5, the author, as city engineer and commissioner of buildings, was asked to attend a meeting called by D. L. Campbell, Premier of Manitoba, at which he took the necessary steps to place the Canadian Army in charge of combating the disaster. Brigadier R. E. A. Morton, General Officer Commanding, Prairie Command, was put in overall charge of the flood fight in the Red River Valley. The author is sure that all present at the premier's meeting were thankful that this move was taken. The armed services have certain advantages in emergencies over a purely civilian organization, such as the ability to requisition labor and materials from the length and breadth of the Dominion and even from outside the country.

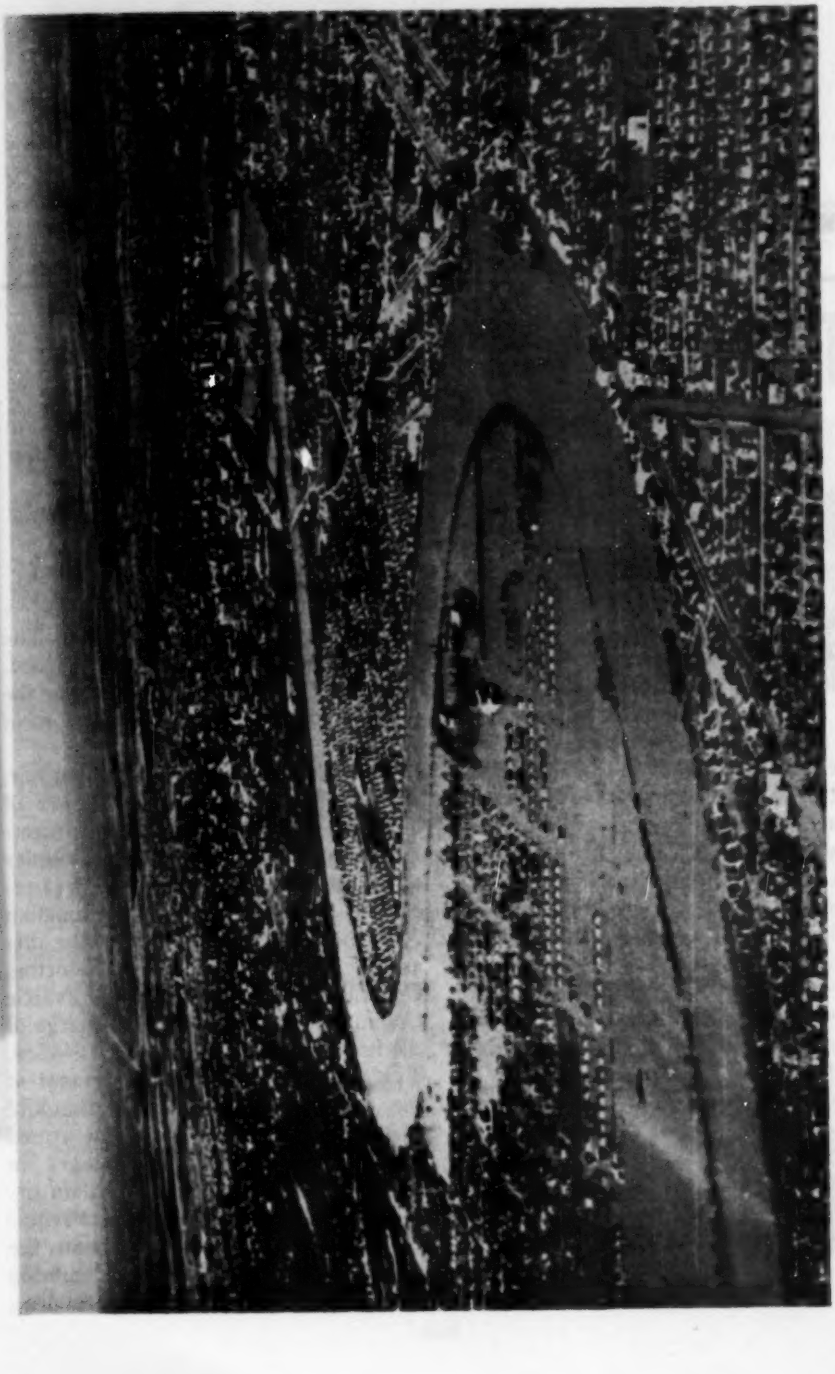

FIG. 1. Aerial Photograph of Riverview District

They have the cooperation of the Air Force and the Navy, providing air and naval transport and specialized services. Large resources of manpower are available to be called up as required, and adequate supervision can also be obtained. Moreover, a civilian is generally prepared to cooperate more readily with a person in uniform than with one wearing civilian clothes. In Brigadier Morton, the services had a wise and skilled commander who enjoyed the confidence of both the man in uniform and the civilian. The Red River Valley owes a great debt of gratitude to this officer for his courageous leadership.

Emergency Organization

During the morning of Saturday, May 6, an emergency meeting of the Winnipeg City Council was held, at which it was briefed on the situation by the author and other city officials. The council, after hearing the reports, set up a committee—consisting of the city engineer, the general manager of the hydroelectric system, the fire chief, the chief of police, the medical health officer and the supervisor of emergency housing—with full powers "to take whatever steps were necessary for the protection of life and property and for the alleviation of distress." The committee was authorized to "incur the expenditures necessary to implement its decisions" and was also given authority "to add to its membership as it might see fit and . . . to cooperate to the fullest extent with the armed services, the Red Cross and other agencies engaged in flood fighting and relief measures." The city engineer was named chairman of the committee and director of operations.

To the best of the author's knowledge, this committee of department heads was given more power than any other had ever received in the history of Winnipeg. It is firmly believed that, all in all, this was a wise move. The committee could meet at any time, night or day, at the call of the chairman. It had the power to carry out necessary decisions, and it was composed of men who had long experience in operating their respective departments and knew their work thoroughly. Moreover, they had the confidence of the public at large.

The city engineer's office was selected as the committee's headquarters, despite the fact that it was on relatively low ground (elevation 32 ft.). This building was already equipped with an emergency diesel unit to supply power and gasoline pumps to keep the basement dry, and it was convenient to the city hall, police headquarters and the central storage yards.

Communications

Communication was now beginning to give trouble. The telephone lines to the Engineering Dept. were choked with calls, and, with the cooperation of the Manitoba Telephone System, a battery of telephones, manned 24 hours a day, was installed to deal with citizen inquiries and to give such advice as might be useful. These special telephone numbers were published daily in the newspapers.

In 1934 the Water Works Branch of the Engineering Dept. had installed radio sets in its trucks, and this system had been expanded until, at the time of the flood, the department had, jointly with the Fire Dept., its own transmitting station at the central yards and 25 vehicle-mounted two-way sets.

Remote-control sets connected by land lines with the main transmitter were available at committee headquarters and at police headquarters. In the meantime, military headquarters was set up at the legislative buildings on Broadway and a remote-control broadcasting station was installed in the Royal Canadian Engineers' Office, thus tying in the city's transmitter with the military. In addition, a direct telephone line was run between committee headquarters in the City Engineer's Office and flood control headquarters in the legislative buildings. A special private line and a remote-control broadcasting station were installed in the author's home so that, night or day, he was able to have contact with committee or military headquarters or with the working parties on the street. The communication system turned out to be one of the most important factors in fighting the flood.

Press Relations

The committee held its initial meeting on May 7, and one of its first acts was to secure the services of Thomas Green of the Winnipeg *Tribune* as press liaison officer. The other daily, the Winnipeg *Free Press,* concurred in the choice.

It was decided that newspaper reporters would be allowed to sit in on all meetings of the committee. The reporters were requested to discuss all matters with the press liaison officer before submitting stories to their papers and news services, but it was agreed that the press liaison officer would not have the power of actual censorship. The committee was anxious to keep the public as fully informed as possible, but there were, from time to time, matters under discussion which might have created panic if reported sensationally and they had to be handled circumspectly.

In retrospect, it can be said that the press and radio were completely honorable and fair in treating the matters under discussion at the committee meetings, and no censorship problem arose during the flood emergency.

Functioning of Committee

The committee held its meetings at ten o'clock each morning and almost at once increased its membership to include the following: the deputy city engineer; the chief engineers of the Winnipeg Electric Co. and the Manitoba Telephone System; the director of the Div. of Sanitary Engineering, Ontario Dept. of Health (Albert E. Berry), who was loaned to the Winnipeg committee by Premier Leslie Frost of Ontario; the director of the Council of Social Agencies; the general manager of the Greater Winnipeg Water and Sanitary Dists.; and the secretary and registrar of the Association of Professional Engineers of the Province of Manitoba, who was named secretary of the committee.

At each meeting of the committee, Mayor Garnet Coulter and the chairman of the city council's finance committee, Alderman C. E. Simonite, were in attendance. Their advice was invariably sought by the committee and, to their everlasting credit, neither of these gentlemen ever attempted to interfere in the functioning of the committee, despite their position of authority.

From Black Friday (May 5), when the river was at elevation 25, it continued rising until May 18, when it reached elevation 30.3. Despite the feverish building of dikes and widespread sewer pumping, real troubles were developing. The steam-heating

mains were flooded and the central steam-heating systems rendered inoperative; two large hydroelectric terminal stations were under water, and only by the most feverish work were they kept in operation; the telephone system was only partially operative; the gas plant suffered severely and was barely kept going; some street-lighting circuits were out of service; and only one of the five bridges across the Red River was open to traffic.

the protection of foodstuffs; and, in cooperation with the director of sanitary engineering for Ontario, for the sanitary protection of the water supply.

The supervisor of emergency housing worked with flood control headquarters on the housing of evacuees and on mass evacuation problems. The power and telephone utilities worked day and night to maintain their services. Even frogmen (divers with specialized equipment) from the Navy were used to service underground cables.

FIG. 2. Downtown Winnipeg

As the situation became progressively worse the Army commander requested the voluntary evacuation of nonessential persons. In five days over 100,000 people left the Winnipeg area. In cooperation with flood control headquarters, the city medical health officer provided for the orderly evacuation of patients from nursing homes and hospitals, for the mass inoculation of the public against typhoid fever and for

The director of the Council of Social Agencies kept the committee informed on social problems and closely cooperated with flood control headquarters. The police and fire chiefs carried an enormous burden in maintaining a crime- and fire-free city and in controlling traffic under difficult conditions. The emergency emphasized the impor-

tance of traffic control in evacuating thousands in time of disaster and the need for adequate highway systems from the metropolitan area to the countryside.

Meanwhile, the Winnipeg Engineering Dept. was endeavoring to keep the sewers operating, the water supply intact and the roads open, and to supply dike-building materials from its sand, gravel and stone plants and other vital equipment and materials from its stores.

The Winnipeg Flood Control Committee was, in effect, a coordinating and cooperating committee, the actual work being carried out by the head of each department, with only general direction from the city engineer. Each department head knew his own problem best, and it would have been the height of folly to replace his direction with outside overall direction. The committee was the clearinghouse, and each department head was willing and anxious to help his colleagues and to seek the advice and assistance of all. The resources of each department were available to all the others wherever possible.

Committee meetings lasted about 1½ hours every morning, after which each department head or committee member returned to his regular work. In the afternoon the daily meetings of the Army–Provincial Flood Control Committee were held. The director and a number of other members of the Winnipeg Flood Control Committee were also members of the provincial committee. Thus, flood control headquarters was kept in close touch with what the city officials were doing and the city committee knew, through its director, what flood control was accomplishing.

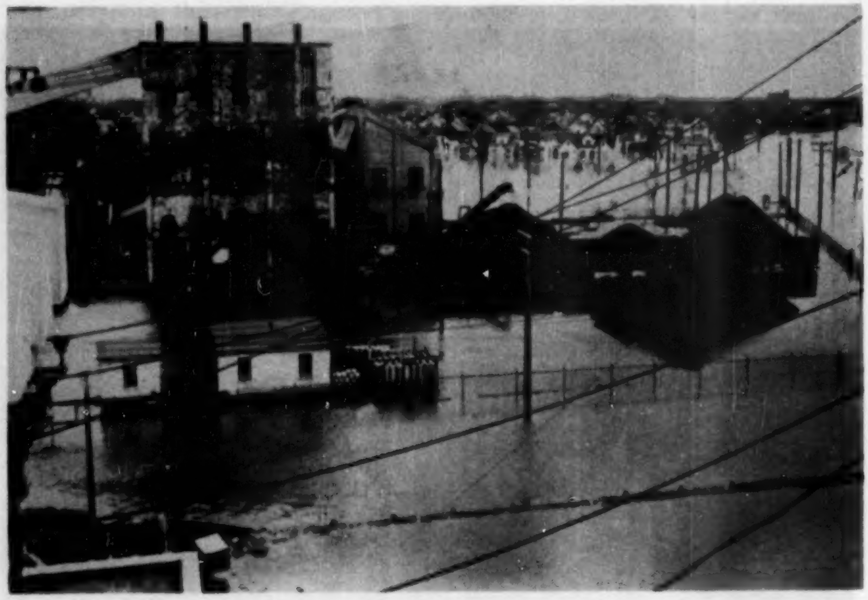

Fig. 3. Winnipeg Electric Co. Gas Plant

Utility Operations

The Engineering Dept. was organized on a 24-hour-a-day basis, and its Water Works Branch established and maintained communication to the various diking areas in Greater Winnipeg. Intercommunication equipment was installed between vital offices in the yard area and the radio control room in the water works building. The true value of the department's radio communications was apparent throughout the crisis. The volume of traffic cleared through this channel during the crucial period between May 5 and May 10 was beyond calculation.

In addition, the Water Works Branch provided approximately 90 men on diking operations throughout the period May 6–May 24. Because they were normally engaged on work of an emergency nature and also because they had an intimate knowledge of the city, water works personnel were particularly suited to the job at hand.

Events at this stage were moving rapidly. The river rose from 24.9 ft. on May 5 to 29.0 on May 10, an average of 10 in. per day. From then on, the daily increase diminished until May 19, when the peak level of 30.3 ft. was reached. This figure was almost 7.0 ft. more than the maximum reached in the 1948 flood, 23.4 ft.

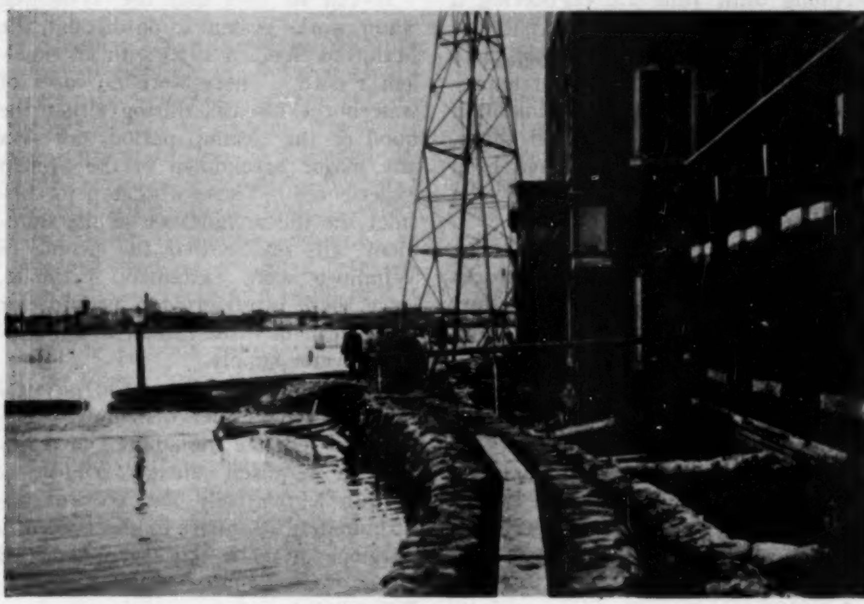

Fig. 4. Hydroelectric Station

A 500-gpm. electrically driven pump was installed in the fire service water works pumping station in order to keep the pipe trench dry. Because of the precarious situation in the hydroelectric terminal stations, a diesel electric standby unit was provided at the McPhillips Street Pumping Station to safeguard the water supply. Investigations were completed and an order placed with local distributors, at 4 P.M.

on May 9, for a 297-kw. caterpillar diesel electric unit. The unit, estimated to cost $33,000, left Peoria, Ill., by low-bed trailer at 9:30 A.M. on May 10, via International Falls, Minn.–Kenora, Ont., and arrived in Winnipeg at 11:30 P.M. on May 12. It was installed at elevation 38 ft. and was connected directly to No. 4 pumping unit, thus insuring a supply of 10 mgd. The standby plant was put into continuous operation on May 17 and ran without stopping until June 15, registering a total of 700 hours. The decision to operate the standby continuously came on May 15, when it was first appreciated how essential it was to maintain pressure on the system at all times. That reason alone would have been sufficient justification for the provision of this equipment.

Normally the domestic booster pumps at the fire service water works pumping station are closed down during the low-demand periods at night. Because central heat was out of service in the downtown area, however, the domestic pumps at this station were operated continuously to utilize heat from the resistance banks to maintain the lubricant on the fire service pumps at a satisfactory operating temperature.

It is probably very fortunate that this arrangement of operation existed; otherwise, even a temporary outage at the McPhillips Street station might have resulted in serious contamination of the distribution system.

Because of the importance of maintaining a safe water supply, A. E. Berry, on May 10, advised increasing the chlorine content to 0.5 ppm. (after five minutes' contact). On May 11, the chlorine residual was further increased to 0.7 ppm., which was maintained until June 17, when it was reduced to 0.5 ppm. It was returned to normal (0.4 ppm. after 7½ minutes' contact) on July 6, after consultation with H. M. Malcolmson of the Manitoba Provincial Health Dept. During the above-mentioned period, 10,696 lb. of chlorine and 1,622 lb. of ammonia were used in excess of normal requirements. It is believed that the high residual in the water supply during the flood period played a most important part in maintaining a relatively high standard of health.

It can be said that the Winnipeg water works system came through the Manitoba flood of 1950 with an excellent record. There were no cases of waterborne disease, during either the flood or the cleanup period, nor was any major breakdown of the system experienced. Those who stop to consider the full significance of the statement will realize that the people of Winnipeg were extremely fortunate, since there is no greater medium for the spread of disease than a contaminated water supply.

A brief description of the physical aspects of the water distribution system will indicate the amount of maintenance required during the flood. Within a relatively flat area of approximately 20 square miles (presently developed), there exists a network of water mains totaling 340 miles (1,795,200 ft.) and ranging in size from 4 to 42 in. In addition, there is over 1,396,000 ft. of service pipe connecting these mains to the individual premises. The entire system lies at a depth of 8 ft. below the surface in a soil particularly active both chemically and physically. More than 50 per cent of the system has been in the ground for at least 40 years, and the life of cast-iron water mains in the Winnipeg area is considered to be between 50 and 60 years.

In 1949, 314 main breaks were recorded. Of this total, approximately 40 per cent was attributable to corrosion, 39 per cent to excess stresses caused by movement of the subsoil and 21 per cent to other factors. During the first three months of 1950, 95 main breaks were recorded, as compared with 68 during the same period in 1949, an increase of approximately 40 per cent. From April 17 to June 24, during which period the Red River was above the 10-ft. level, 45 main breaks occurred.

At this point, it might also be worth while to examine the relationship between the sewerage system and the water distribution system. The sewerage system consists of a second network of pipes—virtually adjacent to the water distribution system—which, though not specifically designed for pressure, was yet subjected to it continuously for weeks as a result of flood conditions. Seven of the nine sewage pumping stations within the city had to be closed down on May 6. After this date, the levels of flow in most of the sewers were governed solely by the elevation of the river. Consequently, these sewers, the majority of which had been in the ground 40 or more years, were operating continuously under heads ranging from 10 to 15 ft. for more than three weeks. Although the system may normally be subjected to similar pressures in flash storms, leakage is not excessive because of the relatively short duration. It will be readily appreciated that, under flood conditions, the unavoidable leakage from sewers operating under pressure is very substantial. This statement is supported by the fact that, up to the present, 70 sewer cave-ins have resulted from the flood.

A vivid example of how sewer pressure made itself evident was shown by a leak, reported at approximately 9 A.M. on May 11, coming through a crack in the pavement about halfway down the north side of the Pembina Highway subway. At first, this was considered to be a water main leak until it was realized that there was no main within several hundred feet of the subway. By that evening, the subway was completely filled with water, necessitating a temporary crossing over the railway tracks.

Prevention of Contamination

Coming back to the subject of the water distribution system, it should not be too difficult to visualize the water mains throughout the entire city being more-or-less surrounded by ground water contaminated directly by sewage. If, for some reason, the pressure within the water distribution system should be allowed to drop below that of the hydrostatic pressure of the contaminated water surrounding the main, then, wherever there was a break in the main, back siphonage would be inevitable. In view of the extent of the system as outlined previously, it is quite reasonable to assume that the possibility of contamination was potentially great.

The problem of contamination was further aggravated because most of the hydrants drain directly to the sewers Under flood conditions, this situation constituted a potential cross connection between the two systems.

The water works staff considered this problem of contamination to be of first importance. Consequently, on April 17, when the river rose to 10 ft. above normal ice level, instructions outlining procedures for avoiding con-

tamination were issued to repair crews (*see* Appendix A).

The duration of the flood made it impractical to leave main leaks running. By May 15 sixteen water main breaks had been recorded, nine of which were still running. It was therefore decided to resume making repairs. The first repair was completed successfully and the main was returned to service by 12 noon on May 16, after it had been sterilized with a 300-lb.-per-day mobile chlorinating unit on loan from the Ottawa Water Works Dept. The Ottawa unit was used in that role until May 26, when the department's new 500-lb.-per-day mobile unit, which had arrived on May 23, was ready for service. The Ottawa unit was returned on June 4, when it was considered that the danger period of contamination to the distribution system was past.

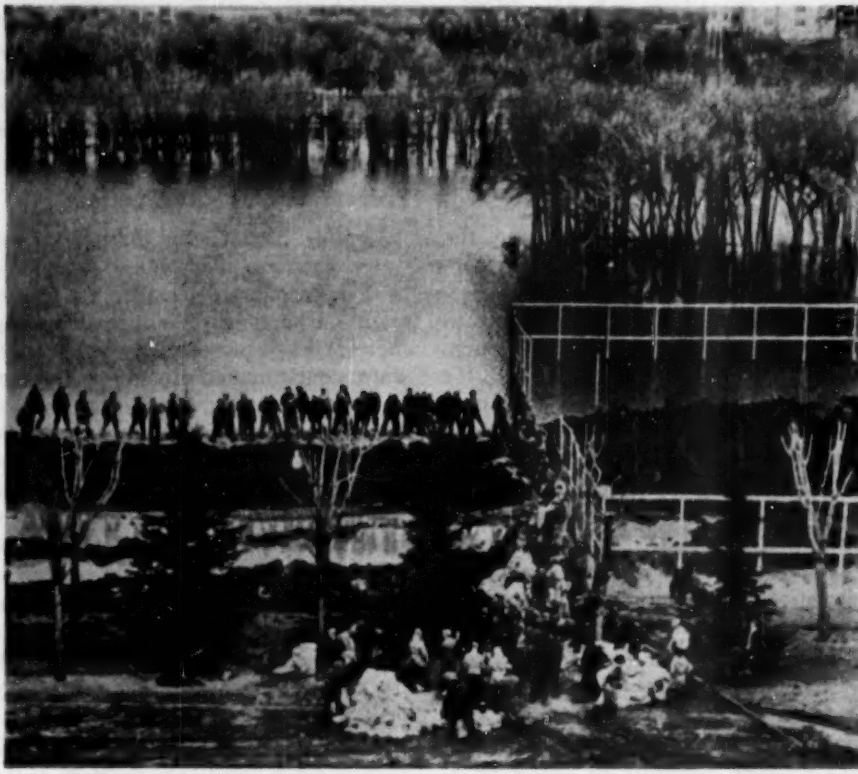

FIG. 5. Sandbag Brigade on Lyndale Avenue Dike

The decision to purchase such a unit had been reached on May 18, as it was thought advisable to have available ample mobile chlorinating capacity in the event of extensive contamination of the system in the inundated areas. Berry was of the opinion that it might be necessary to sterilize large sections of the distribution system. After consid-

ering the difficulties involved in carrying out such a plan, however, it was decided to wait until there was a definite indication of contamination in these areas. Further, it was not known to what extent this type of equipment would be required by outside municipalities.

Berry and Lougheed felt that contamination would be unlikely as long as the water showed a trace of chlorine.

FIG. 6. Typical Sandbag Dike

Residual chlorine tests were taken twice daily at about twenty locations throughout the city. As the water receded, extensive flushing of the hydrants in the low-residual area was carried out.

As a precautionary measure, the chlorination of repaired water mains was continued until June 17. Approximately 35,000 ft. of mains, ranging in size from 4 to 12 in., was sterilized in conjunction with the 45 main breaks repaired during the flood period. This required a total of 51½ hours of chlorinating time and 650 lb. of chlorine. The average additional cost for sterilization amounted to approximately $90 per main break.

Reestablishment Committee

While the fight against the flood was at its peak, the city engineer recommended the setting up of a reestablishment committee, composed of the following members: the general manager of the Greater Winnipeg Water and Sanitary Dists., chairman; the director of the Sanitary Engineering Div., Ontario Dept. of Health; the medical health officer; the chief of the Fire Dept.; the assistant manager of the city hydroelectric plant; the engineer of water works and sewerage; the engineer of inspections; the regional supervisor of the Central Mort-

gage and Housing Corp.; the district chief of the Fire Dept.; the chief health inspector; the director of social agencies; the superintendent of the Public Welfare Dept.; and the supervisor of emergency housing registry.

The functions of this committee, which held its first meeting on May 14, were:

1. To draft a coordinated plan of the work required to reestablish all the necessary facilities, such as water, sanitation and electricity, and to arrange for the reoccupation of premises in the flooded areas as soon as possible.

2. To estimate the additional personnel, equipment and material required to carry out the above-mentioned work.

3. To recommend the taking of immediate executive action considered necessary in securing personnel and equipment at once, if required, to avoid subsequent delays.

4. To assist in the coordination and planning of private organizations, such as the Manitoba Electrical Assn. and the Builders Exchange, to enable them speedily to rehabilitate the homes and electrical appliances damaged by the flood.

The draft plan for reestablishment of the water works system, prepared by the water works staff in consultation with Berry and Lougheed, appears in Appendix B.

Lessons Learned

Since those hectic days, the water works system has gradually returned to its normal operation. Many invaluable lessons were learned. Such items as standby equipment will be given more consideration in future planning. Communication facilities will be readily expanded to cover emergency conditions. The flood factor will be an essential consideration in the design of new installations.

Water works personnel carried out their duties throughout the crisis in a most commendable manner. Many mistakes were undoubtedly made, and unnecessary procedures may have been followed, incurring much added expense. The important fact, however, is that a safe water supply was maintained. One case of contamination might have resulted in a widespread epidemic. Perhaps the people of Winnipeg realized the seriousness of contamination, since there were very few complaints about the water supply, although it carried more than three times the normal amount of chlorine.

The following is a summary of a few of the author's reactions, now that the crisis is past, in connection with a civic committee to deal with disaster:

The author believes that the city council was wise and farsighted in setting up a committee of department heads and others to carry out Winnipeg's flood-fighting efforts during the catastrophe. One can well appreciate the qualms that must have arisen in the minds of the members of council, who were elected by the citizens of Winnipeg to represent them, over delegating part of their responsibilities to a group of appointed officials. The council fully realized, however, that this was a time for action—sufficient time was not available for business to be conducted in the normal manner. The city council assured the functioning of the committee by vesting it with adequate authority and providing it with the necessary funds.

At the risk of sounding pompous, the author would like to outline the qualities which he believes a director

of such a committee should have: [1] an intuitive capacity for leadership; [2] the ability to analyze a complicated set of facts and to issue directives quickly in order to accomplish his purpose; [3] the ability to cooperate with the members of his committee without antagonizing them by being overbearing or self-important, for it must be remembered that, at such times, nerves are frayed and actual physical fatigue is greatly in evidence; and [4] the ability to inspire the respect and confidence of the city council and of the citizens.

An important consideration of the committee should be the setting up of adequate press and radio relations.

Experience has demonstrated the advisability of providing adequate supplementary accounting facilities. A competent financial man, to assist the committee in establishing proper accounting procedures during such a period, is highly desirable and necessary. Because of time limitations, however, he should not be placed in a position of determining whether an expenditure should or should not be made.

When the emergency is over, the committee should disband and normal conduct of city business should be resumed. The Winnipeg committee voluntarily disbanded on May 27.

In speaking of the flood emergency, Mayor Coulter has stated that Winnipeg:

> had an extremely valuable experience in carrying out mass evacuation and in organizing the volunteer services, safety measures and protection for essential institutions and services in which authority of action was centralized in a competent head who worked with experienced Civic Department heads and competent citizen executives who were in constant consultation with central authority; that the general public recognized the emergency and cooperated fully with assistance of radio and press; that the general opinion here is that the important thing in any such action is the centralization of complete power in a competent leader, assisted by executive heads with experience and common sense; and that our experience in this crisis was that our people will cooperate and volunteer when they recognize sensible leadership.

The author believes that the committee was successful in its efforts. The Winnipeg *Tribune* said editorially that the committee's "job was to save power terminals, bridge approaches [and] communication [facilities,] and safeguard the water supply . . . it was successful in nearly all these battles and . . . Winnipeg [owes] a debt of gratitude to the Civic Flood Control." To those who had gone through this harrowing experience, it was gratifying to realize that their sins of commission and omission were not being held against them.

Steps for Preparedness

The Winnipeg organization and experiences give some lead as to what might be useful in other emergencies, but certain things should be done in the way of preparation for the future.

A volunteer system capable of rapid expansion, if not already in existence, should be created so as to draw in all of the community. Competent leaders with training and experience in organizational work should be preselected and should work in the fields with which they are familiar.

Block or area plans with centralized headquarters should be worked out and should be capable of being applied to the area concerned.

Most important of all, existing organizations, such as the Red Cross, the Central Volunteer Bureau, the Council of Social Agencies, community clubs, service clubs and youth groups, can play a substantial part in mobilizing human activities and in directing personnel to work at jobs in which they have had some experience.

Every disaster will create its own problems, and it is not possible to set out ahead of time each and every step that should be taken. Excellent manuals on dealing with disasters can be prepared in advance, however. An example of such a manual is "Disaster Preparedness," issued by the League of Minnesota Municipalities. The U.S. Army Corps of Engineers has prepared an excellent manual on flood emergencies, and during the last war both the director of air raid precautions for the government of Canada and the governments of several provinces issued some valuable manuals in connection with air raid precautions. These would be useful in setting up procedures to deal with emergencies, but they are no substitute for capable direction.

Disaster preparedness manuals should be compiled by the senior governments, as this work is obviously beyond the scope of local organizations. Such manuals should set out the lines of authority and procedure in advance and should contain the germ of a workable disaster plan, even though the actual work will have to be carried out by a local organization familiar with local conditions. Had such a manual been in existence at the time of the Winnipeg flood, matters would surely have been made much easier.

It is difficult at best to improvise during times of crisis. Had a general plan been laid out in advance, it would have been possible to adopt such changes as experience showed were necessary to make it effective, and a great deal of time and effort would have been saved in evolving satisfactory procedures and methods, although it is doubtful whether more could have been done than was accomplished in the Winnipeg area. This achievement can be attributed largely to the excellent cooperation received from volunteer workers on the dikes and on other essential jobs and to the employment intact of such bodies as the Red Cross, the Central Volunteer Bureau, the Independent Order of the Daughters of the Empire, the service and community clubs and other organizations of public-spirited citizens whose services were made available to the authorities. To these must go the greatest credit for the success of Winnipeg's flood fight.

In fighting the flood, Winnipeg has willy-nilly secured valuable experience in civil defense matters. Although the enemy involved was nature and not man, many of the problems which arose would be common to manmade disasters.

APPENDIX A

Contamination of Water Distribution Facilities in Flooded Areas

During the 1948 flood period considerable trouble was experienced in keeping water out of excavations within the flooded areas. This condition constitutes a potential danger to the water system by the possibility of contaminated water entering the system. Should there be any doubt as to whether contaminated water has entered the mains, it will be necessary to chlorinate before that portion of the main can go back in service.

The following procedure is provided in order that every precaution will be taken to avoid possible contamination:

1. Before starting any excavation, the foreman will check the plan kept on the office board which will have the danger areas marked in red. If the job is within the indicated area, the foreman will contact the Engineer of Water Works and Sewerage for further information or instructions.

2. Service leaks and main leaks in red areas will not be turned off or repairs started without the permission of the Engineer of Water Works and Sewerage or the Assistant Engineer of this Branch. However, in the case of large breaks where extensive damage may be caused, sound independent judgment will have to be used. In these latter cases, the main will not be put back into service until permission is obtained.

3. In the danger areas hydrants are not on any account to be used to release pressure on or to drain a section of main. In other areas when a hydrant is used for such purposes, it is to be closed immediately the pressure is released.

4. During a period of emergency, hydrants in the red area are to be checked by the hydrant inspectors for water standing in the hydrant post. Any such hydrants will be reported to the office immediately where steps will be taken to have them chlorinated.

5. If in doubt in any particular case, contact the Engineer of Water Works and Sewerage, the Assistant Engineer or the Engineer of Pumping Stations.

APPENDIX B

Water Works Reestablishment

Problem

1. The maintenance of a safe water supply to points of consumption is absolutely essential. The restoration of the water supply to this condition, wherever it may have been damaged as a result of the flood, is a matter of first priority.

Method

2. The City will endeavor to maintain adequate pressure by using simultaneously two independent pumping stations, namely:

a. Pumps connected to normal power.

b. Diesel electric unit electrically coupled to No. 4 pump unit at McPhillips Street Station.

This will insure a supply of approximately 10 mgd.

3. A high chlorine residual will be maintained throughout the entire system during the tenure of this crisis (0.7 [ppm.] at both pumping stations).

4. In the event of a serious water main break, the section of the main in question will be closed down, repaired, if possible,

and the main sterilized by allowing a solution of at least 50 ppm. to stand for at least four hours.

5. The following procedure will be used for sterilization of the mains and services:

a. Shut off main.

b. Repair main as soon as possible.

c. Inject solution 50 ppm. in main.

d. Flush main.

e. Enter premises and instruct the occupants to flush the entire system by opening every faucet, including the hot water tank, for fifteen minutes. (Use the drain cock at bottom of tank to clear out accumulation in base of tank.)

6. Where the Medical Health Officer finds it necessary, he will order that all water to be used for drinking purposes, or the preparation of food, should be boiled during the first 24 hours, or until clearance has been obtained from him.

7. In the case of services turned off for repairs, the above procedure of flushing the system will be followed. Repairs can only be made where the level of the water is below the point of repair.

8. This procedure also applies where a service has been off for a considerable time and a turn-on is requested.

9. In areas which have been completely inundated, the following procedure will be used:

a. Wherever practical, the entire area will be fed from one supply main. An endeavor will be made to fill the system with a solution of 50 ppm. for a 24-hour period, following which the mains will be flushed.

Occupants will be instructed to flush their entire systems for a period of fifteen minutes and, where deemed advisable, the Medical Health Officer will instruct them to boil all water used for drinking purposes and preparation of food until they have obtained a clearance from him.

b. Where *a* is not practical, a high residual will be maintained in the water supply (0.5 to 1.0 [ppm.]). As the water recedes, the distribution system will be flushed through accessible hydrants.

The occupants will follow the procedure outlined in *a* and will be required to obtain a clearance from the Medical Health Officer.

Responsibility

10. The Water Works Branch will be responsible for the carrying out of the above instructions, but the final responsibility of determining the safety of the water supply will remain as it now does, with the Medical Health Officer.

11. The Water Works Branch is cooperating with the Health Department in making bacteriological tests of water from the distribution system in the various inundated areas of the City.

Resources

12. The City of Winnipeg Water Works Department has the necessary staff and equipment to cope with all probable work that may arise as a result of the flood. Some additional equipment, including a 500-lb.-per-day mobile chlorinator, is now on order, which, together with the one on loan from Ottawa, is considered to be adequate for the City's requirements.

13. If required, the Water Works Branch can give a certain measure of assistance to the other municipalities, including supervisory help.

Regulation of Air Conditioning and Other Refrigeration

Committee Report

A committee report presented on May 26, 1950, at the Annual Conference, Philadelphia, by Frank C. Amsbary, Jr., Chairman, Committee A1.C—Water Use in Air Conditioning and Refrigeration. The other members of the committee were: Elwood L. Bean, Logan L. Lewis and Marsden C. Smith.

IN its first report (1), presented at the 1949 Annual Conference, the Committee on Water Use in Air Conditioning and Refrigeration outlined several objectives which it wished to realize before the 1950 meeting:

1. To obtain the cooperative attention of the manufacturer of refrigerating equipment to the seriousness of water demand with the feeling that the industry can do much in the design of equipment to reduce this to a minimum
2. To investigate demand charges for water as the possible solution of many problems
3. To sample the reaction of regulatory bodies to the problem
4. To submit a guide, or outline regulations, for the consideration of those whose systems are indicated by study as needing such an approach for the solution of their immediate problems.

The first progress report provoked a considerable amount of discussion. It started on the floor at the 1949 Conference after the report had been given and continued in an article (2) in *Engineering News-Record,* which was followed by letters from readers giving their opinions, pro and con, on the thesis that the water utilities should push water sales to the limit, regardless of use. These discussions were concerned with the entire field of water use, of which this committee is detailed to study only a part.

The committee considers this atmosphere healthy and has welcomed the publication of these discussions. It is felt, however, that the objectives sought in the committee's work were not clearly understood, probably due to inadequate explanations last year.

To clarify the committee's position, its study is being confined to two classes of water systems. One class consists of those where the source of supply is inadequate or approaches inadequacy, with little hope of augmenting it economically. This matter involves natural resources and represents a situation which is either desperate now or promises to become so. The second class comprises those water systems with a source of supply which is presently adequate and will not become a problem at some future date, but where some link in the chain of physical plant facilities will be jeopardized if air-conditioning and other refrigerating loads are not controlled. This situation will at some time in the future affect every water plant. The cost of tearing up streets for the pur-

pose of enlarging sewers or water mains, or the enlarging of filter plants to meet purely summer loadings, cannot be justified where these loadings can be reasonably avoided.

For the first class mentioned above, immediate restrictions on use are the only answer. For the second class, restrictions on use are not suggested; rather, through measures for conservation and the elimination of waste, the public utility should keep the demands within such economic limits that, if inadequacy approaches, augmentation of the physical plant facilities may be financed by the revenue received from the customers creating this inadequacy. Each customer should bear his share of the burden that he himself creates, and the customer who continues to use water at normal rates the year round should not be discriminated against through increased rates to finance improvements required by the low load factor usage of others. The applicability of this principle is generally becoming recognized.

Attitude of Refrigeration Industry

The committee feels that it has done rather well in its work with the refrigeration industry. Through the efforts of Logan L. Lewis, a member of the committee, one half-day session of the American Society of Refrigerating Engineers' 1949 Annual Meeting was devoted to this problem. Elwood L. Bean, a member of this committee, gave an excellent paper on the problems which refrigeration in all its applications presents to the water supply industry. The sections of this paper which deal most specifically with the matter of regulations appeared in the February 1950 issue of *Refrigerating Engineering* (3), the official publication of the A.S.R.E.

The presentation of this paper was followed by a luncheon with representatives of manufacturers and engineers. The most important outcome of this meeting was the request that the A.W.W.A. committee prepare a series of articles for the Refrigeration Service Engineers Society's monthly publication. A few of these articles have been prepared and more are in process. The committee has been scheduled to be represented at a regional meeting of the R.S.E.S. in St. Louis on May 27, 1950, to present the problem to that group. The A.S.R.E. has again devoted a half day to this problem in the program for its Kansas City meeting on June 6, 1950.

The committee feels that in demand charges lies the solution to many problems of the water industry. The institution of a demand charge to be applied to any commercial or industrial installation the character of whose load would justify such an approach, would solve not only the economic problem presented by refrigerating demands, but that of all other installations where short peak demands create a similar difficulty. If the demand charge is the answer, it will remove the grounds for an accusation of discrimination. It must never be forgotten that there are in existence many other uses which are an economic burden on the water utility, and thus an economic burden on all its customers.

Basis for Charges

There is a variance of opinion on the proper basis for demand charges. One approach is a fixed charge based upon the size of the meter, in addition to the consumption charges. The com-

mittee does not believe that this method is an adequate solution as it does not take into consideration the load factor which governs economical operation of any water plant or other utility. Demand charges based on fifteen-minute intervals are the most common practice in the power industry, and the committee feels that this procedure would be equally applicable in the water supply industry.

The problem of producing a demand meter that may be economically purchased, operated and maintained has not been solved. Although the wishes of the committee for the development of such a meter have been called to the attention of the meter manufacturers and several are working diligently on the problem, none has come up with the answer. The committee will continue its search for a demand meter, and it hopes that, at some future date it may announce success in this effort.

A third method that may be employed to place air-conditioning and other refrigerating water use on an economic basis is a special rate to be applied to all accounts operating on a low load factor.

The end result of any of the above methods, if rates are properly based, would be to encourage the installation of water conservation equipment, thereby reducing water costs. Even if water conservation equipment is not used, the customer will be paying on a basis that makes such an account economically desirable to the utility.

Results of Survey

The committee corresponded with the 26 state regulatory bodies, including that of the Territory of Hawaii, to sample their attitude on demand charges or regulations to control these peak demands. Fifteen replies were received. The questions and a summary of the responses are given below.

1. *"If such a [demand] meter is developed, and a satisfactorily supported demand rate schedule is presented to you, would it receive favorable consideration?"* Of those replying to this question, eight stated that the demand meter principle would receive careful or favorable consideration, three preferred a sliding-scale minimum and two were opposed. One preferring the sliding-scale minimum opposed the demand charge basis on the theory that water could be stored. The committee believes that this argument overlooks the heavy carrying charges needed for building adequate storage and increasing the capacity of other classes of physical plant to meet a 1,000-hour load (out of 8,760 hours in the year) that may be imposed by air conditioning. Two respondents did not express themselves on this question.

2. *"If a demand meter is installed that requires electrical energy not exceeding 10 w. to operate, would you approve connecting to the consumer's power circuit and giving the consumer no credit for power used?"* Of the eight replies approving a demand meter in principle, five saw no objection to connecting to the customer's light circuit and giving no credit for the cost of the energy used. In support of this approach, one stated: "Many of our telephone users now furnish electricity necessary for operating certain telephone equipment for local needs." Another stated: "Where power supply is necessary as an accessory to some other type of utility service, it is common practice for this to be supplied directly by the customers." Another stated: "It would be considered as one

of the costs involved in providing service and, therefore, properly chargeable to the customer." One was opposed to the use of energy without due credit being given the customer. One conditioned his reply as follows: ". . . if agreeable to the consumer under Section — of the laws of the State, which provides for arrangements between the company and the consumer." One did not state his position for or against but observed: "Current used to operate a demand meter would have to be considered in the light of conditions existing at the time when [the matter is] presented for consideration."

The committee believes that the above statements add support to the demand meter approach, and it should be expected that the energy required would, generally speaking, be supplied by the customer.

3. *"Certain conditions may indicate that a rule and regulation be adopted in preference to demand charges; would such rules and regulations receive favorable consideration?"* Five affirmative replies were received, while the balance failed to answer. It seems to be of some importance that none answered "no."

Model Ordinance

The committee presents in the Appendix to this report a form which may be used for guidance in the preparation of an ordinance regulating the installation and operation of air-conditioning and refrigerating equipment. The committee is not presenting or recommending this form as proper for general adoption. The conditions and circumstances of the individual utility, its finances, methods of procedure and adequacy of personnel, all vary greatly. Likewise, the necessity or desirability of control, its purpose and urgency, and complications encountered are variables. Legal controls and verbiage are also variables, since no language is universal. The best solution for the individual community should be worked out by the water engineer and his legal adviser in cooperation with local refrigeration equipment representatives. The "model" form provided contains a wealth of ideas, *each section of which should be considered, and modified or adopted as local circumstances dictate.*

References

1. Committee Report. Regulation of Water Use in Air Conditioning. Jour. A.W. W.A., **41**:715 (Aug. 1949).
2. Gannett, Farley. Let's Sell Water. Eng. News-Rec., **143**:21:39 (Nov. 24, 1949).
3. Bean, Elwood L. Refrigeration and the Water Supply Industry. Refrig. Eng., **58**:140 (Feb. 1950). *Reprints obtainable at $0.35 per copy from Am. Soc. of Refrigerating Engrs., 40 West 40th St., New York 18, N.Y.*

Editorial Note

No statement in the following "Model Ordinance" is to be taken to approve, or imply approval of, the use of water from a public supply *and* the subsequent return of such used water to the mains of the water utility.—*Harry E. Jordan.*

APPENDIX

Model Ordinance Regulating Installation and Operation of Air-Conditioning and Refrigeration Equipment *

Whereas, the operation of water-cooled refrigeration and other equipment for changing the dry-bulb temperature or the humidity of air has rapidly increased and now involves the use of water in quantities never before anticipated, thereby placing unexpected burdens on the public water supply system which are detrimental to other classes of water service,

And whereas, in the interest of the public and its water supply system, it is necessary to regulate the use of water for such purposes and to require conservation of water and elimination of waste,

Now, therefore, be it resolved, that the following regulations shall apply to all water-cooled equipment installed for the purpose of reducing the dry-bulb temperature or decreasing the absolute humidity of air, whether for comfort air conditioning, refrigeration, processing or whatever other purposes:

Sec. 1—Definitions

For the purpose of these regulations, the following terms shall have, and shall be construed to have, the following meanings:

a. The terms "air-conditioning system" and "refrigeration system" shall include any combination of equipment, whether compressor or other type, by which heat is removed from the air and from which the accumulated or effluent heat is wholly or partially removed by the use of water.

b. "Air-conditioning system" shall mean an installation for maintenance, by heat removal, of temperatures which are not less than 60°F.

c. "Refrigeration system" shall mean an installation for maintenance, by heat removal, of temperatures which are less than 60°F.

d. "System" shall mean any combination of apparatus, individual unit, group or collection of units supplied with water through any single customer service pipe connected to the public water system.

e. "Person" shall mean and include a natural person, partnership, corporation or association. Whenever used with respect to any penalty, the term "person," as applied to partnerships or associations, shall mean the partners or members thereof, and as applied to corporations, the officers thereof.

f. "Superintendent" ("Commissioners," "Director" or other title) shall mean the chief officer of the (name of water utility) or such officer or agent as he shall duly authorize to act in enforcement of these regulations.

Sec. 2—Permit Required

No person shall install, operate or use any equipment for air conditioning or refrigeration which requires a supply of water from the system of the (name of water utility) without first having procured written permit therefor from the Superintendent.

Sec. 3—Application for Permit

3.1. Application for permit shall be made to the Superintendent and shall provide the following information:

* The term "ordinance" is to be taken in its general meaning. A comparable document may be issued by the appropriate authority in any municipality empowered to issue regulations or orders.

a. Name and address of the applicant.

b. Location of the premises where installation is proposed.

c. Name and address of the owners of the premises.

d. Names of manufacturers of the units requiring water.

e. Manufacturer's identification and classification of the refrigeration units.

f. Manufacturer's rating of maximum refrigerative capacity of the unit or units under the conditions of the planned installation. (Rating may be stated in tons per 24 hours or in Btu. per hour.)

g. Horsepower of compressor prime mover, if unit is of compressor type.

h. Where water conservation devices are required (to comply with Sec. 7 hereof), the manufacturer's name, identification, classification and size of the conservation equipment.

i. Elevation and plan showing general piping arrangement and details of all points of connection to building supply water piping (piping direct to condenser units, makeup supply into tower pan and so forth).

j. Such additional information as shall be required by the Superintendent.

3.2. Applications shall be signed by the owner or tenant, and applications for installation shall designate a plumber duly qualified to receive permits under other sections of these regulations.

NOTE: For the purposes of these regulations, in no event shall the rated capacity in tons be considered less than the following: [1] total maximum Btu. per hour of capacity of the installation divided by 12,000; or [2] the nameplate horsepower of any compressor prime mover unit, for any air-conditioning installation; or [3] two-thirds the nameplate horsepower of [2] above, for any refrigeration installation.

In the absence of the required manufacturer's maximum rating (Sec. 3.1 (*f*) above), the Superintendent may specify the tonnage of the installation at the ratings indicated by [1], [2] or [3] above; or, if these appear inadequate, then by whatever other measure of capacity appears to him to be proper.*

Sec. 4—Fee for Permit

A fee shall be paid, at the time of application for a permit, to cover one inspection of the installation. The fee shall be ——— dollars, plus ——— cents per ton of capacity. For each additional inspection required because of condemnation of work, or because of premature request for inspection, an additional charge shall be made, equal to 75 per cent of the original fee.†

Sec. 5—Permit to Install

5.1. Permits to install piping or connect equipment will be issued at <u>(title and address of permit-issuing office)</u> but only in the names of licensed and bonded plumbers who are duly registered to perform plumbing work within the area of the premises involved, or to plumbers in the employ of the municipal, state or federal governments for premises in their respective charge.‡

* In using methods [2] or [3] above, the Superintendent must realize that, for purposes of evading some restrictions recited herein, the motor may purposely be improperly sized, or erroneous ratings may be stated. Therefore, the inspector must be satisfied of proper sizing or rating when using these methods.

† The amount of fees under this section should be determined by the local water utility, based upon local costs incurred in comparable inspections.

‡ If the municipality does not require plumbers to be bonded or licensed or registered, it is recommended that the same standards already in use in the locality be adopted in the above section.

5.2. Within 48 hours following the completion of any work authorized by permit, notice of completion and request for inspection shall be returned in writing, by the plumber receiving the permit, to the office from which the permit was obtained.

Sec. 6—Permit to Operate

After final inspection and approval of the installation, a permit to operate or use the equipment will be issued at (title and address of permit-issuing office) in the name of the owner or tenant.

Sec. 7—Water Use and Conservation

7.1. Systems with a capacity of ——— tons (per 24 hours) or less shall not use water directly (or indirectly, except when used with conservation equipment) from the public supply.*

7.2. Systems with a total capacity of more than ——— tons (per 24 hours) but not exceeding ——— tons (per 24 hours) may use water directly from the public supply, at a rate not exceeding 2.0 gpm. per ton if the water temperature is 75°F. or less, or 3.0 gpm. per ton if it is above 75°F., provided they are equipped with an automatic regulating valve which will [1] stop the flow of water when the refrigerating machine is shut down and [2] throttle the flow of water down to the momentary requirements of the system.†

7.3. All systems having total capacities exceeding ——— tons (per 24 hours) shall be equipped with evaporative condensers, cooling towers, spray ponds or other water-cooling equipment.‡ This equipment shall be of sufficient capacity to insure conformance with the requirements in Table 1 for makeup water when operating under full loading at maximum summer temperatures.

Sec. 8—Sanitary Protection

8.1. On installations which operate with the use of water directly from the public supply system, every direct connection shall be equipped with a suitable brass-body, brass-fitted check valve installed in the branch supply line to each unit.

TABLE 1

Maximum Allowable Water Use

Water Hardness *ppm.*	Max. Use *gpm./ton*
0–139	0.1
140–199	0.15
200–254	0.2
255–339	0.3
340–424	0.4
425 and over	0.5

8.2. Discharge connections for the disposal of waste waters shall be in strict accordance with applicable rules and regulations of state and local health and regulatory bodies.

8.3. Cooling waters which are to be reused for other purposes shall be pro-

* The local utility should determine the limits as may be found most suitable to local conditions. Air-cooled units up to 3-ton capacity have been found practical if conditions of installation afford passageway for the proper volume of cooling air to and from the condenser.

† The first blank in Paragraph 7.2 is to be filled in using the same value as was decided upon in Paragraph 7.1 of this section. The value used for the second blank must again be determined by local conditions. It has been found that 5 or 5.5 tons is the most generally accepted limit. Whether the dividing line between conservation and no conservation is to be lower or higher than the stated 5 or 5.5 tons is entirely a local problem, which must be solved according to the facts existing in each individual community.

‡ The blank in the first sentence of Paragraph 7.3 is to be filled in using the same value as was decided upon for the second blank in Paragraph 7.2.

vided with free, above-the-rim discharge before entering other equipment; otherwise, permission shall be obtained in writing from the Superintendent, approving the proposed connections and use.

8.4. On installations other than those described above, there shall be a physical break between the public water supply piping and the piping of the installation, so arranged as to make impossible back siphonage to the public water supply system.

Sec. 9—Revocation of Permit

Any permit which is issued under these regulations to operate or use equipment may be revoked by the Superintendent for any one of the following reasons:

a. Failure of the holder of the permit to discontinue using water for the purposes covered by the permit, immediately upon notice to do so issued by the Superintendent during an emergency or to forestall an impending emergency.

b. Alterations, changes of equipment or piping, improper operation or lack of maintenance which results in conditions that [1] are hazardous to the potable water supply either within the premises or in supply mains, or [2] cause unnecessary waste of water.

c. The use of water is found to exceed the quantities permitted under Sec. 7 of this ordinance.*

* Many municipalities have general provisions in their administrative codes for giving notice and holding hearings. If such provisions are not sufficiently broad to cover this ordinance, it is recommended that the municipality include a provision for giving ten days' notice to the consumer and for holding a hearing before the water department, prior to discontinuing water service. Where such a provision is added, the municipality should examine its police powers to confirm that they are sufficiently broad to terminate service in the event the public health is in danger.

Sec. 10—Effective Date

10.1. For new installations, these regulations shall be effective fifteen days after adoption. Publication shall be made in accordance with provisions of any applicable laws, acts, opinions, ordinances or regulations.

10.2. Existing installations shall be modified to conform to the provisions of these regulations; applications to operate shall be filed and permits shall be obtained. Modifications shall be completed and permits obtained in accordance with the provisions of this paragraph within six months after adoption.

10.3. Existing installations conforming to the provisions of these regulations in all matters except the conservation of water shall not be penalized under provisions of Sec. 11 for failure to provide conservation for a period of one year after adoption. Such installations shall, however, be subject to all other provisions of these regulations six months after adoption. In the event that a critical condition develops in the system, subsequent to fifteen days after adoption, all installations not equipped to conserve water shall be subject to immediate discontinuance on orders of the Superintendent.

Sec. 11—Penalties

11.1. Failure to comply with the above regulations shall be sufficient cause to penalize the licensee by:

a. Payment of ——— dollars per ton capacity, but not to exceed ——— dollars for each violation. Each day that such violation continues shall constitute a separate violation.

b. Discontinuance of service for failure to correct the violation promptly after notification or failure to pay penalties within ten days after notification of their imposition.

11.2. Any person who violates the provisions of this ordinance and fails

to comply with notification to correct such violation and to pay the penalties assessed, or who repeatedly violates such provisions, may be deemed guilty of a misdemeanor and, upon conviction thereof, shall be subject to a fine not exceeding ten times the penalty previously stated, or imprisonment for not exceeding 100 days, or both such fine and imprisonment.

11.3. Licensed plumbers guilty of violation of any of the rules and regulations herein shall be prohibited from securing further permits from the (name of water utility), and, where willful violations warrant, the Superintendent may prefer charges to the proper authority, seeking revocation of the plumber's license.*

Sec. 12—Inconsistent Ordinances

All regulations, ordinances or parts of ordinances heretofore in effect which are in conflict with, or which are inconsistent with, the provisions of this ordinance, to the extent of their inconsistency are hereby repealed.

Sec. 13—Separability

The invalidity of any section, clause, sentence or provision of this ordinance shall not affect the validity of any other part thereof which can be given effect without such invalid part or parts.

* If the municipality has an administrative code setting forth the procedure to be followed for hearings, this procedure should be incorporated in the ordinance in connection with the imposition of penalties. If no such procedure now exists, the municipality should provide for hearings before the water department prior to the imposition of any penalty.

Fluoridation of Public Water Supplies

By F. J. Maier

A paper presented on Oct. 17, 1950, at the Southwest Section Meeting, New Orleans, La., by F. J. Maier, Sr. San. Engr., U.S. Public Health Service, Bethesda, Md.

SOME of the most important contributions to the improvement of public health have been made through the application of procedures designed to remove from drinking waters substances injurious to health. Conversely, the discovery of the role of optimum amounts of fluorides in water has led to the concept that the treatment of drinking water might include the addition of specific substances to prevent disease.

Fluorides are added to drinking water in order to reduce tooth decay. Where necessary, fluorides are removed from water to prevent dental fluorosis. That the removal of fluorides from water will prevent one disease, while their addition to water will prevent another, entirely different defect from developing, is one of the most curious reversals in the history of water supply engineering.

The role of fluorides as the causative agent of dental fluorosis has been known since 1931, although a description of the lesion had been reported 30 years previously. Fluorosis in its mildest forms produces chalky-white spots or causes the entire crown surfaces to turn chalky white. As fluoride concentrations increase, secondary, brown to black stains appear, and, in the severest cases, the enamel shows a pitted and eroded surface which chips and crumbles easily, resulting in a degree of enamel attrition not commensurate with the chronological age of the individual affected.

Fluorosis becomes evident in children if, during the period of enamel calcification, they have been consuming water which contains more than about 1.5 ppm. of fluoride ion. The effects of fluoride concentrations in water will differ, of course, as the amounts of water consumed and the susceptibility of individuals vary. The lesion becomes more severe as the concentration of fluorides increases, until, at 6.0 ppm., practically all children are affected, many with a marked to severe type causing considerable disfigurement.

On the other hand, it has been shown that 1.0 ppm. fluoride naturally occurring in water is sufficient to decrease the incidence of dental caries by more than 60 per cent. The accompanying degree of fluorosis is negligible.

Studies are now in progress to demonstrate that this reduction in caries incidence can be duplicated by artificially adding fluorides. The oldest of these studies, started in January 1945 at Grand Rapids, Mich., with 1.0 ppm. fluoride, has shown recently that the incidence of caries experience among children aged five to seven is practically the same as that in children in the same age groups at Aurora, Ill.

(Fig. 1). The fluoride content of the Aurora water supply is 1.2 ppm. There are no discernible reasons for suspecting that each successive yearly examination at Grand Rapids will not follow the same trend. There is no evidence, either, that 1.0 ppm. of the fluoride ion naturally occurring in water is different in effect from the same concentration derived by dissolving a fluoride compound in water.

cent reduction in decay rates of the permanent teeth was reported after 40 months of fluoridation. There are, in addition, more than 40 other places in the United States where fluoridation is practiced, most of them being in Wisconsin.

Fluoride Concentration

In most of the earliest fluoridation projects, a concentration of 1.0 ppm.

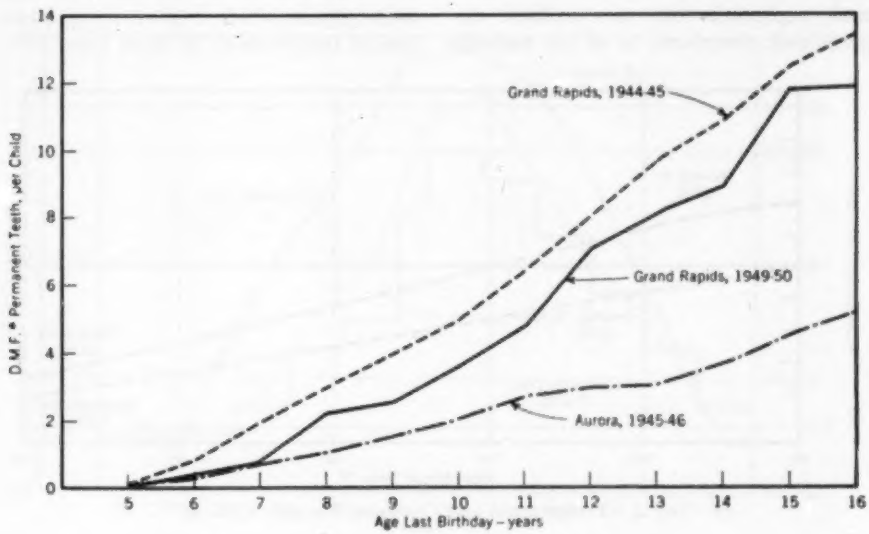

FIG. 1. Caries Experience at Grand Rapids and Aurora

* Decayed, missing and filled.

Similar caries reductions have been noted at other places where fluorides are being added. For example, at Newburgh, N.Y., where fluoridation was started in May 1945, a 30 per cent reduction in caries in permanent teeth was found among children in the six-to-twelve age group.

At Sheboygan, Wis., where fluoride was first added in February 1946, a 20 per cent reduction was shown in three years. At Brantford, Ont., a 22 per

or slightly higher has been used. This rate of feed is based essentially on the conclusions reached by H. T. Dean of the U.S. Public Health Service in his study of 7,257 selected children in 21 cities in Illinois, Indiana, Ohio and Colorado (1, 2). A fluoride concentration of 1.0 ppm. is probably the optimum for this north central area of the country, but not necessarily the best for all areas.

The severity of fluorosis and the de-

gree of caries protection varies (within limits) with the fluoride intake. The quantities of fluoride ingested are generally dependent on the amounts of water consumed. Consumption, in turn, hinges in part on the temperature and relative humidity of the locality. It has been suggested that the optimum fluoride rate of feed is the highest concentration which will not produce more than about 10 per cent fluorosis. A 10 per cent incidence of endemic fluorosis represents the very mildest degree and, therefore, is of no esthetic consequence; it is, in fact, generally unrecognizable.

What is needed, then, in order to determine the optimum rate of feed for a given locality, are sufficient data from places where public water supplies contain 0.5–1.5 ppm. fluoride; where the fluorosis prevalence is about 10 per cent among children at least 14 years of age; where reliable data on humidity and mean annual temperatures are available; and where there is a sufficient number of children to justify a valid conclusion. Unfortunately, such data have been obtained from too few such communities to formulate definite conclusions. Nevertheless, all available information has been plotted in Fig. 2 to indicate very roughly the possible relationship between the optimum fluoride content of municipal water supplies and mean annual temperatures (1, 2). Also shown in Fig. 2 is the percentage prevalence of fluorosis found at the various cities noted.

Perhaps the most that can be ascertained now from such a curve is that those places which experience a mean annual temperature of more than 55°–60°F. should supply water containing less than 1.0 ppm. fluoride. Mean annual temperatures alone may not, however, be the best basis for estimating water consumption in some communities. For example, more water may be consumed in an area where the days are very hot and the nights cold than in a locality with a more uniform temperature but the same mean annual temperature. Relative humidity is also an important factor to be weighed. Data on considerably more communities will have to be accumulated before this suggested curve can be regarded as

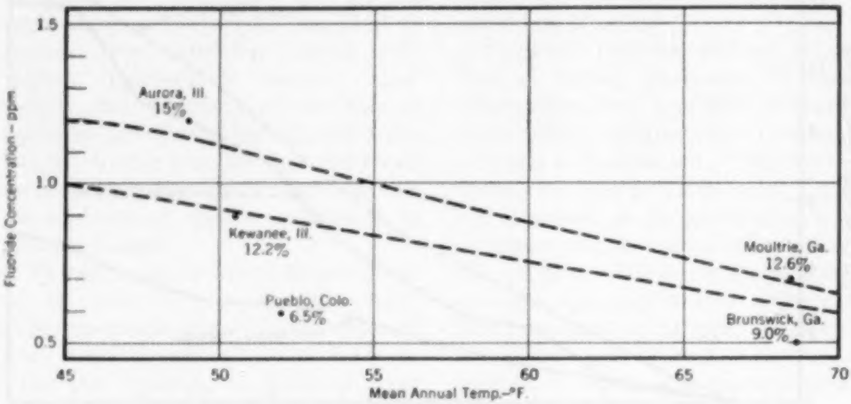

FIG. 2. Temperature and Optimum Fluoride Content

entirely practicable. Eventually it will be possible to construct a graph from which, when the local mean annual temperature (or mean daytime temperature) and relative humidity are known, the optimum fluoride feed can be read directly.

At Charlotte, N.C., Z. M. Stadt, Dental Officer, City Health Dept., has concluded that an equivalent of 0.9 ppm. fluoride should be added. The mean annual temperature at Charlotte is 61.9°F. As shown in Fig. 3, Stadt and R. S. Phillips, Supt., Charlotte Water Dept., have gone further and correlated average monthly temperatures, probable variations in water intake (based on carbonated-beverage sales) and the resulting variable fluoride feed (3).

A fluoride concentration which is set too high, although providing increased caries protection, will cause an excessive amount of fluorosis and, possibly, result in an embarrassing series of lawsuits. One such incident might well discourage fluoridation projects scheduled for many other communities.

Fluoride Compounds

Early fluoridation projects employed sodium fluoride as the source of fluoride. This compound was adopted because it was commercially available in large quantities, was convenient to use and had a solubility which was relatively high and constant over a wide temperature range; also, studies on its toxicity and physiological effects had been completed.

Obviously, there are many other compounds which might be used. Table 1 lists, in order of solubility, those fluoride compounds which, because of their present availability, cost, purity and freedom from ordinarily undesirable ions, appear to be suitable for fluoridation. There are, of course, other compounds (potassium fluoride, magnesium fluoride, sodium bifluoride)

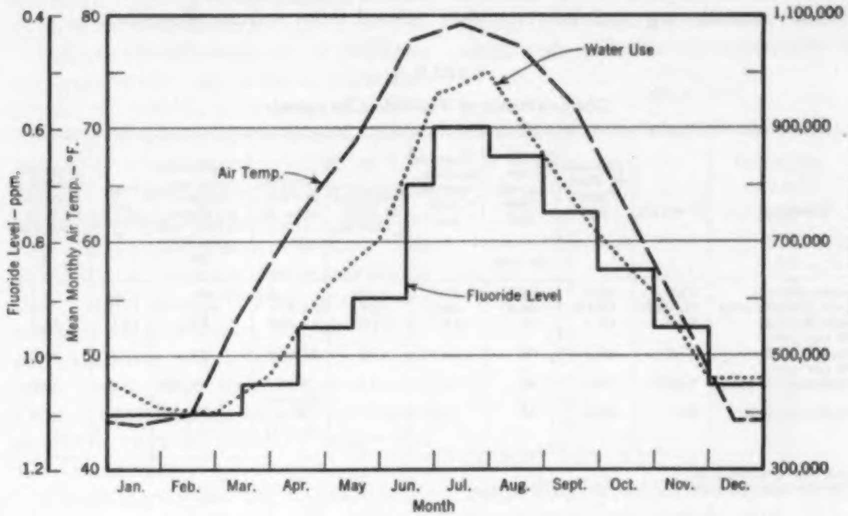

FIG. 3. Water Consumption, Air Temperature and Fluoride Level

which may become more attractive in the future. Some fluorides have obvious advantages over others. For instance, the calcium salt is the cheapest source of fluoride, but because of its insolubility it would be difficult to feed. It might well become the preferred fluoride, however, in some of the larger plants, where it could be fed directly into the water.

The acid fluorides (particularly hydrofluoric acid), although considerably more expensive, can be fed directly without considering solubility. At corrosiveness and the danger inherent in its handling, hydrofluoric acid should not be used in water plants unless the most expert supervision is available.

Balancing cost against convenience in handling, it appears that sodium silicofluoride might be the most promising source of fluoride at present. Racine, Wis., has been able to purchase it at 3.23¢ per pound delivered, which, from the standpoint of cost per pound of available fluoride, makes it about one-fifth as expensive as the fluoride obtained from sodium fluoride.

TABLE 1

Characteristics of Fluoride Compounds

Chemical	Formula	Fluoride in Pure Chemical	Purity of Commercial Chemical	Fluoride in Commercial Chemical	Solubility at 25°C. *g./100 ml.*	Fluoride in Satd. Soln. at 25°C. *ppm.*	Amt. of Soln. per mil.gal. of Water (25°C., 1.0 ppm. F^-) *gal.*	Cost per Pound ¢	Cost per Pound of Commercially Available F^- ¢
		per cent							
Calcium fluoride	CaF_2	48.8	98.0	47.7	0.004	19.1	52,500	2.0	4.2
Sodium silicofluoride	Na_2SiF_6	60.64	98.8	60.0	0.762	4,572	219	3.23	5.4
Sodium fluoride (90 per cent)	NaF	45.3	94	42.5	4.05	17,200	58.2	10.5	24.8
Sodium fluoride (98 per cent)	NaF	45.3	98	44.4	4.05	18,000	55.6	11.5	26.0
Hydrofluosilicic acid	H_2SiF_6	79.0	30	23.7		Fed directly	3.35*	5.0	21.0
Hydrofluoric acid	HF	95.0	60	57.0		Fed directly	1.42†	13.5	23.7

* Specific gravity 1.26.
† Specific gravity 1.24.

Madison, Wis. (4), 70 per cent hydrofluoric acid is used in order to conserve space in a series of small well pumphouses. The acid is proportioned indirectly with a solution feeder. Instead of pumping the acid (which is extremely corrosive), the feeder forces an inert mineral oil into the top of the acid tank. The oil, riding on the acid, displaces a volume of acid equal to the amount of oil pumped. Corrosion difficulties in piping and fittings appear to have been overcome by using Monel metal or hard rubber. Because of its

Most of the sodium silicofluoride produced today is a by-product of the phosphate salt and phosphate fertilizer industries. It is derived from phosphate rock (containing calcium fluoride and fluoapatite) which has 3–4 per cent fluorine. Silicon tetrafluoride, evolved when the rock is acidified, can be converted to hydrofluosilicic acid by reacting with water, but in most plants it is allowed to escape into the atmosphere or is absorbed in waste water. By reacting the hydrofluosilicic acid with a sodium salt, sodium silicofluoride is

formed. It is estimated that over eight times the present annual consumption (10,000 tons) of sodium silicofluoride could be produced at the present rate of phosphate salt production (5). It appears then, that, from this source alone, there is enough fluoride now available to add 1.0 ppm. to the water consumed by the entire population of the United States. Recent, unpublished studies by F. J. McClure have shown that the availability of the fluoride ion in sodium fluoride is comparable to that in sodium silicofluoride.

Sodium silicofluoride is a crystalline, nonhygroscopic salt with a molecular weight of 188.05, a density of 2.679, a density of saturated solution of 1.0054 and a pH of saturated solution of 3.5–4.0. The hydrolysis permits direct analytical determination by titration with a standard alkaline solution. The solubility at various temperatures is shown in Table 2. Two grades are available commercially, regular (72 lb. per cubic foot) and fluffy (55 lb. per cubic foot). Both sodium fluoride and sodium silicofluoride can be purchased in 100-lb. bags, 375-lb. fibre drums and 425-lb. barrels.

The relatively low and variable solubility of the salt will make it somewhat more difficult to feed as accurately as sodium fluoride. Solution feeders will require either a relatively large solution tank (219 gal. (at 25°C.) per million gallons of water treated) or a smaller tank with the salt fed as a slurry. Feeding a slurry requires constant agitation of the mixture and a design for the feeder valves and slurry lines which will prevent clogging. If hot water is continuously available (particularly at softening plants employing carbonation), a constant high-temperature water can be utilized, which will result in lower solution water requirements. For dry feeders, a larger solution box requiring more water will be necessary, as compared with a feeder using sodium fluoride.

Fluoride Feeders

Devices for feeding fluorides accurately have generally been adapted from those machines originally designed for feeding a variety of chemicals in water treatment and industrial plants. Feeders can be broadly divided into two types: [1] solution feeders, where a measured quantity of accurately prepared fluoride solution is delivered during a specified period; and [2] dry feeders, where a predetermined quantity of the solid material is delivered during a given time interval. The choice of a feeder depends on the rate at which fluoride is required. This rate, in turn, is determined by the water consumption and the fluoride content of the untreated water. Solution feeders are used for smaller supplies and dry feeders for larger ones. There is, of course, a wide area within which either type would be equally successful.

TABLE 2

Solubility of Sodium Silicofluoride

Temp. °F.	Solubility *oz./gal.*
32	0.58
50	0.72
77	1.02
95	1.25
104	1.40
113	1.50
122	1.62
131	1.78
140	1.98
176	2.60
212	3.26

Solution feeders in single units have heretofore been used for supplies de-

livering up to about 2.0 mgd. Such units have a maximum delivery rate of about 400 ml. per minute. When sodium fluoride is used, the solution strength is usually brought up to 3.0–3.5 per cent, although this concentration can be made much lower, if desired, where the water supply is very small. If excessive amounts of calcium or magnesium are present in the solution water, calcium fluoride or magnesium fluoride will precipitate, settle out and become lost. To prevent this in a saturated fluoride solution, the solution water should not contain more than 20 ppm. calcium (50 ppm. as $CaCO_3$) at 25°C. The concentration of magnesium may reach 50 ppm. (210 ppm. as $CaCO_3$) at the same temperature before precipitation occurs.

A more concentrated solution of sodium fluoride can be obtained with a recently developed saturator, in which water passes down through a bed of crystalline sodium fluoride (6). The sodium fluoride rests on a straining device so that a saturated solution of the fluoride can be withdrawn by the feeder. For this purpose, a sodium fluoride of larger particle size (20–40 mesh) has been produced which permits an increase in the rate of flow of water through the bed. The withdrawal rate must not exceed the rate of flow through the fluoride. A similar grain size for sodium silicofluoride would be most desirable.

Where a community is supplied with water from several different sources, the use of several small solution feeders is more economical than any attempt to bring the supplies together at a central point for treatment. Multiples of these single units may also be used at a central point. In such situations, however, a larger solution tank is required or the solution must be made up more frequently. In general, it has been more economical and convenient to use dry feeders when the daily consumption exceeds about 2.0 mgd. Solution feeders cost about $250 without auxiliary equipment.

Solution feeders of various capacities and refinements in construction can be obtained from: Graver Water Conditioning Co., New York; Hills-McCanna Co., Chicago; Infilco, Inc., Chicago; Lapp Insulator Co., Leroy, N.Y.; Milton Roy Co., Philadelphia; Morse, Boulger Destructor Co., New York; Omega Machine Co., Providence, R.I.; Permutit Co., Inc., New York; Proportioneers, Inc., Providence, R.I.; T. Shriver and Co., Inc., Harrison, N.J.; and Wallace and Tiernan Co., Inc., Newark, N.J.

Dry feeders are of two general types: [1] volumetric feeders which deliver a measured volume of dry chemical within a given time interval; and [2] loss-in-weight feeders (gravimetric) which deliver a measured weight of chemical within a given period.

Single volumetric feeders have been used for supplies delivering between 2.0 and 5.0 mgd. Disk type volumetrics, however, can deliver up to 25 lb. of sodium fluoride per hour and roller types, up to 18 lb. per hour. If these maximum rates could be used, up to 32.6 mgd. could be treated. The volumetric feeder is utilized while resting on scales. The hopper holding the dry chemical may be fitted with a dust collecting system. These feeders cost $350 or more.

Volumetric feeders of sufficient accuracy for fluorides are manufactured by: B. F. Gump Co., Chicago; Infilco, Inc., Chicago; Jeffrey Manufacturing Co., Columbus, Ohio; Omega Machine

Co., Providence, R.I.; Permutit Co., Inc., New York; and Wallace and Tiernan Co., Inc., Newark, N.J.

Gravimetric, loss-in-weight, feeders have been used for the larger supplies. They are capable of feeding up to 5,000 lb. per hour, which exceeds the greatest demand on any supply in the United States. On the other hand, they are capable of feeding accurately as little as 10 lb. per hour. They are fitted with solution boxes and their built-in weighing mechanism provides a constant indication of the rate of feed. The hoppers are generally filled from the floor above and are fitted with dust collectors. Feeders of this type cost $2,000 or more, depending on size and accessories.

Slight overdosage has occasionally occurred when the solution box was flooded with fluorides. This condition results when the chemical forms an arch in the hopper. When the arch collapses, the fluorides are forced over the feeding mechanism. This disadvantage reportedly has been eliminated with the development of a locking mechanism.

Manufacturers of gravimetric feeders include: Jeffrey Manufacturing Co., Columbus, Ohio; Omega Machine Co., Providence, R.I.; and Wallace and Tiernan Co., Inc., Newark, N.J.

Small feeders are generally connected electrically with the pump motors to stop the feeder automatically when the pump stops. Manual adjustment of the rate of feed is easily made on all feeders when changes in the amount of water to be treated can be anticipated. If these changes are not predictable, feeding rates can be varied automatically, with solenoid valves actuated either by a venturi or water meter.

The mechanics of feeding fluorides (except hydrofluoric acid) are no more involved than those for other chemicals used in water purification. The major differences may be that fluorides are toxic (but so is chlorine) and that an overdosage is difficult to correct. Even with a 100 per cent overdose, however, the resultant fluoride content will not exceed approximately 2.0 ppm. This concentration will produce no perceptible ill effects, even when continued for a week. Nevertheless, the rate of application should be maintained as constant as possible and close to the dose determined as optimum for the supply in question. Valuable information can be obtained from every community using fluoridated water. The interpretation of valid data will be contingent on a history of uninterrupted use of water containing a constant, static fluoride concentration. No valid or useful conclusions can be drawn from a study where the concentration has varied considerably and intermittently.

Point of Application

The point of application of the fluoride is an important factor. Almost every water supply presents a different problem, sometimes involving a compromise between what is considered the best point of application and the best place to replenish the feeder hopper. In general, fluorides are applied most effectively at that point where the risk of losing them in a subsequent treatment is least.

Untreated supplies present the fewest problems. Fluorides can be introduced either into a reservoir (if the influent rate is known), into the well directly, or into the discharge or suction side of the pump. Feeders capable of discharging solutions against any

head encountered in water supply practice are available.

In treatment plants, consideration should be given to processes which have a tendency to remove fluorides. These include lime softening in the presence of magnesium; alum or sodium aluminate coagulation; feeding of bentonitic clays; and activated-carbon treatment at low pH values. As little as 10 ppm. alum, when added to water with 1.0 ppm. fluoride, will remove about 0.1 ppm. of the fluoride. It is therefore advisable to add fluorides after these treatment steps. If settling is prolonged and efficient, and if the filters remove relatively little material, fluorides can be added before filtration. On the other hand, if the load on the filters is considerable, fluorides should be added after filtration, generally either in the line between the filters and the clear well or in the clear well itself.

Chlorine can be added anywhere in the plant or distribution system. There are no known reactions between fluorides at 1.0 ppm. in water and compounds formed in water after chlorination. Fluorides at this concentration have no bactericidal effects.

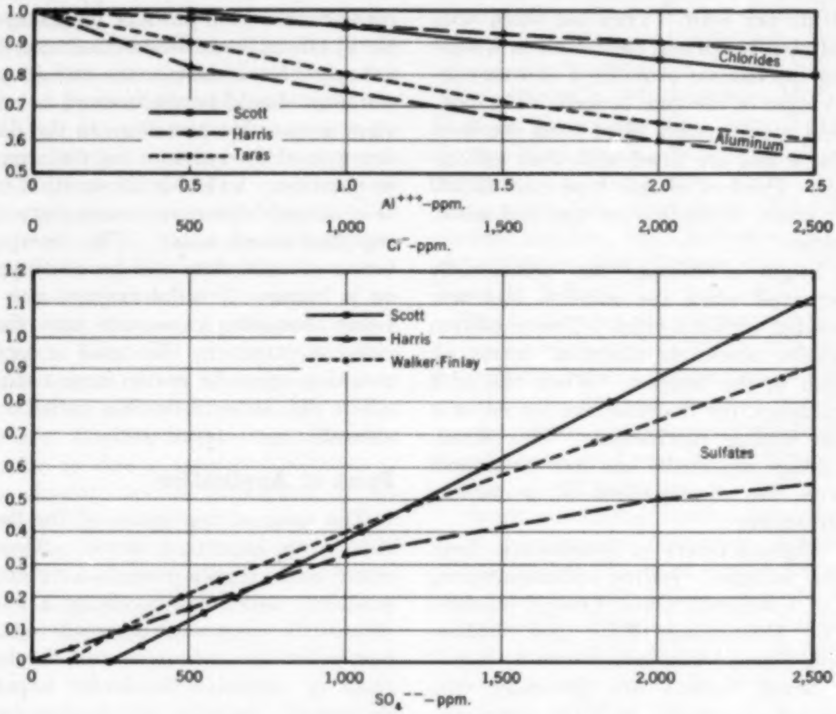

Fig. 4. Range of Ionic Interference *

* References: Scott (10), Harris (15), Taras (14), Walker-Finlay (13).

Side Effects

There are no noticeable effects of 1.0 ppm. fluoride on taste, odor, color, hardness or pH value. No untoward

effects have been reported by bottlers, brewers, bakeries, laundries or chemical plants. At Charlotte, N.C., where the supply is relatively unmineralized (total solids, 43.7 ppm.; hardness, 22.8 ppm.; chlorides, 2.8 ppm.; and sulfates, 4.3 ppm.) cracking of ice blocks in ice manufacturing plants increased about 50 per cent apparently after 1.0 ppm. fluoride was added (7). This phenomenon was completely eliminated by adding the equivalent of 20 ppm. ammonium chloride to the water used for ice making. No other such experience has been reported. Colorado Springs, Colo., with a water supply very similar to Charlotte's (except that 2.8 ppm. fluoride is naturally present), has had no trouble of this kind, but, in any event, the phenomenon should be investigated.

Fluoridation will provide all or part of the fluorides needed to remove silica from boiler water. An ion-exchange process is reported to require the addition of about 1.0 ppm. fluoride for each 0.5 ppm. SiO_2 removed (8). On the other hand, if sodium silicofluoride is used for fluoridation, about 0.5 ppm. SiO_2 is formed when 1.0 ppm. fluoride is added from this source.

After fluoridation has been started, the fluoride content of sewage almost immediately reaches the same concentration as in the water supply. This phenomenon has had no effects on any sewage treatment process.

Home softening units using the salt regeneration system will not remove the added fluorides.

Records and Sampling

In even the smallest installations, daily records should be kept of water treated and amounts of fluoride fed. After it has been ascertained that the optimum fluoride concentration is reaching all points in the distribution system, sampling schedules at the plant and in the system are formulated primarily to check inaccuracies of the feeder and unexplained losses in the system. Actually, if a feeder is well maintained and adjusted, its accuracy should be well within 5 per cent. This accuracy is greater than that attained by present tests for fluorides in water.

The standard test for fluoride is based on the degree of decolorization of a zirconium-alizarin lake in an acid solution (9–11). In general, this reagent is relatively unstable, the color range is narrow, the color development requires about an hour, and many other ions in water interfere with the reading. So far, the best reagent of this type is that developed by Lamar (12) in 1945. It is more stable and its color range appears to be broader than is true for other reagents. Interference with other ions is considerably reduced.

TABLE 3

Upper Limits of Ionic Interference Using Scott-Sanchis Reagent to Give Maximum Error of Approximately 0.02 ppm. Fluoride

Substance	Fluoride Reading Too Low If More Than:	Fluoride Reading Too High If More Than:
	ppm.	
Chlorides	500 (2,500—Lamar)	
Aluminum*	0.10	
Alkalinity (as $CaCO_3$)	150 (400—Lamar)	
Sulfates		150 (1,000—Lamar)
Iron		0.5
Phosphates (PO_4)†		1.6–3.3
Phosphates $(PO_3)_6$†		0.3
Chlorine		0.02‡
Manganese		0.02‡

* Ref. 15.
† Ref. 16.
‡ Ref. 14.

As shown in Fig. 4, interference by other ions using the present standard method (Scott-Sanchis) is considerable. In addition, a 0.10-ppm. free chlorine residual considerably decolorizes the lake, producing an apparent increase in fluorides. It has been reported that water containing 1.8 ppm. chlorine can be dechlorinated by adding one drop of 0.1*N* sodium thiosulfate per 100 ml. of sample (14). Ultraviolet rays obtained either from sunlight or lamps will also dechlorinate the fluoride sample.

If the quantities of interfering ions exceed the maximums shown in Table 3, the most accurate procedure is to distill the sample in perchloric or sulfuric acid (17). The distillate will contain all the fluorides and practically none of the interfering ions. If the excess of these ions is not too great, the sample might also be diluted with distilled water and the fluoride content of the aliquot determined in the usual way.

Setting up a series of standards—a laborious step in the fluoride determination—is no longer required in routine analysis where the accuracy desired is within 0.20 ppm. fluoride and the interference is negligible. Permanent color standards of glass or liquid are available and can be fitted into a comparator. The color gradations of the liquid standards in sealed tubes are based on the Lamar reagent; those of the glass standards, on the Scott-Sanchis reagent.

Safety Measures

No skeletal changes, except the mildest forms of dental fluorosis, have ever been observed in individuals who have continually used water containing 1.0 ppm. fluoride. Damage to the bones (osteosclerosis) has occurred after 2½ years' continuous exposure to cryolite and phosphate rock dust, whereby probably 15–25 mg. fluoride per day was inhaled (18). Industrial hygienists have set a threshold limit of 2.5 mg. fluoride per cubic meter of air. Present practice in water treatment plants is to obtain equipment permitting the fluoride feeder hopper to be filled no oftener than once a day. If reasonable care is used in handling the fluorides so as to produce the least dust, little danger to the operators is involved. Actually, the greatest hazard occurs in the larger plants, where the fluorides are dumped from a barrel into a hopper opening which is at floor level. Occasionally the fluoride arches in the barrel and then, suddenly emptying, throws a cloud of dust into the air. In such installations a dust exhaust system should be made part of the hopper equipment.

Hopper exhaust systems usually involve a series of socks hung in a steel enclosure opening into the top of the hopper, adjacent to the feeding door. A motor-driven fan draws air from the hopper through the socks and exhausts to the atmosphere. At Oshkosh, Wis., the suction is derived from an aspirator type water eductor. The sodium silicofluoride dust entrained in the water is carried to a sedimentation basin.

When filling hoppers, the operators should wear masks. Those of the type BM2101,* equipped with a filter designed for dusts (BM2133),* are satisfactory.

In smaller plants where the hopper or solution tank is replenished by means of a scoop, little or no dust is generated if the fluorides are handled carefully. Here, too, however, a mask should be worn. Rubber gloves should also be worn and the hands washed after each filling. Spilled fluorides should be wet-mopped and discarded.

* U.S. Bureau of Mines designation.

The crystalline sodium fluoride, now available in a larger particle size (20–40 mesh), should reduce the dust problem to a minimum, because a very low percentage of this material contains particles small enough to form dust.

Initiation of Fluoridation

Many fluoridation projects have been started as a result of the interest created by local dental and medical societies. Many of these groups have presented their evaluations of reports containing factual and convincing proof of the benefits demonstrated at places where fluorides are naturally present and, lately, where they have been artificially added. The local councils, with or without a public hearing, but always with public support, have then authorized (sometimes by ordinance) the local water departments to proceed.* Permission and advice are always obtained from the state health department, and, where applicable, an opinion on liability is obtained from the state attorney general. These opinions have always reiterated the water department's liability for damage resulting from negligence. Money for fluoridation has come from the general fund or from health or water department appropriations, but usually from the health department.

Summary

Before adding fluorides to the water supply, these points should be observed:

1. There is a possibility, particularly in the southern latitudes of the United States, that too much fluoride may be added, with the result that an undesirable degree of fluorosis may develop.
2. Operators should be trained to recognize the toxicity of fluorides and to handle them safely.
3. Dosages should be made as accurate and as constant as possible.
4. Complete records should be kept of the amounts of water treated and the quantities of fluoride used.
5. Daily fluoride tests of samples from the plant and distribution system should be made and recorded.

In the light of evidence obtained from places which have long used water containing the optimum fluoride concentration, and, lately, from those communities which are adding fluorides, it can be recommended that plans approved by the state health department for fluoridating the water supply should be formulated. Every delay

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* A.W.W.A. official policy as published in the JOURNAL (19) states (Sec. 4) that:

The operating management of a water supply utility should begin the addition of fluoride in the water supply only after:

4.1. The governing body of the municipality has authorized fluoridation by ordinance, and the local and state health authorities have approved the addition of fluoride and have: [1] established reasonable maximum and minimum limits of fluoride, stated in parts per million, to be maintained in the water supply; [2] approved the type of chemical feeding equipment to be installed and used; [3] approved the installation of equipment, plant layout and methods of handling the fluoride compound to assure the safety of employees; and [4] approved the method of analysis and control to be used in determining the fluoride content of the water before and after the addition of fluoride.

4.2. The state or provincial public utility commission has released, when required, any necessary orders—for example, a method by which the utility will be reimbursed for the expense of fluoridation.

4.3. The legal counsel of the water department or company has made a finding that all necessary authorization has been given to the water utility so that legal liability for damages will be limited to negligence.

4.4. The board of directors or similar governing body of the utility has, by resolution, instructed its proper operating officers and employees to add fluoride as specifically authorized by the controlling health and municipal authorities.

deprives children of a substantial health benefit which may be obtained at a negligible cost.

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American Dental Association Approves Fluoridation

On November 2, 1950, the House of Delegates of the American Dental Assn., at its annual convention in Atlantic City, N.J., adopted a resolution approving the fluoridation of municipal water supplies and recommending the continuation of controlled studies on the subject. The text of the resolution follows:

Whereas, numerous studies have demonstrated a decreased incidence of dental decay associated with the presence of fluoride occurring naturally in drinking water, and

Whereas, there is a rapidly accumulating body of data derived from direct studies of the artificial addition of fluoride to drinking water, and

Whereas, these data provide convincing evidence of the safety of this procedure and of its benefits in terms of reduced incidence of dental caries, therefore be it

Resolved, that in the interest of public health, the American Dental Association recommends the fluoridation of municipal water supplies *when the fluoridation procedure is approved by the local dental society and utilized in accordance with the standards established by the responsible health authority*, and be it further

Resolved, that the American Dental Association recommends the continuation of controlled studies of the benefits derived from the fluoridation of water supplies.

California Pollution Control Legislation

L. W. Grayson

A paper presented on May 24, 1950, at the Annual Conference, Philadelphia, by L. W. Grayson, Supt., Water Dept., Riverside, Calif.

LEGISLATION affecting water pollution in California was first recognized as a far-reaching problem with the adoption of House Resolution No. 27—at the 1947 regular session of the state legislature—which created the Fact-Finding Committee on Water Pollution. The preamble to this resolution stated that pollution "is a problem requiring exhaustive analysis, intelligent treatment and widespread education of all concerned; . . . a preliminary draft of legislation to control pollution of water sources has been prepared, which document is considered to be too far-reaching in its effect and too narrow in its adjudication and administration to warrant the support which should be given to a fair and impartial effort to solve the problems of industrial wastes."

This position was not taken by the California legislature until two years after the alarming Montebello Dist. phenolic water pollution case occurred, in connection with which it is well to refer to Roy O. Van Meter's excellent paper on the subject (1). Van Meter's article describes how the water works operators and officials, through the California Section, A.W.W.A., carried an appeal to the governor and other state officials of California, joining hand in hand with the legislative committee in the very extensive study needed even to hope for a reasonable approach to the solution of the pollution control problem.

Possibly the most controversial issue during the 1949 legislative session was the water pollution question, which finally saw the enactment of a series of eleven bills authorizing and establishing a state water pollution control program.

Dickey Act

Assembly Bill No. 2034, Chapter 1549, referred to as the Dickey Water Pollution Act, added Division 7 to the Water Code. This act contains chapters on "State Policy," "Definitions," "State Water Pollution Control Board" and "Regional Water Pollution Control Boards." Under "State Policy" the act declares the necessity for control at a local level by regions and further provides for the authority of counties and cities to be recognized. In the chapter on "Definitions," "pollution" is defined as an impairment of the quality of water adversely affecting it for beneficial use, including domestic, industrial, agricultural, navigational, recreational or others; and "Contamination" is defined as the impairment of water quality to the extent that an actual hazard to the public health is created.

State Pollution Control Board

Chapter 3, "State Water Pollution Control Board," provides for a board

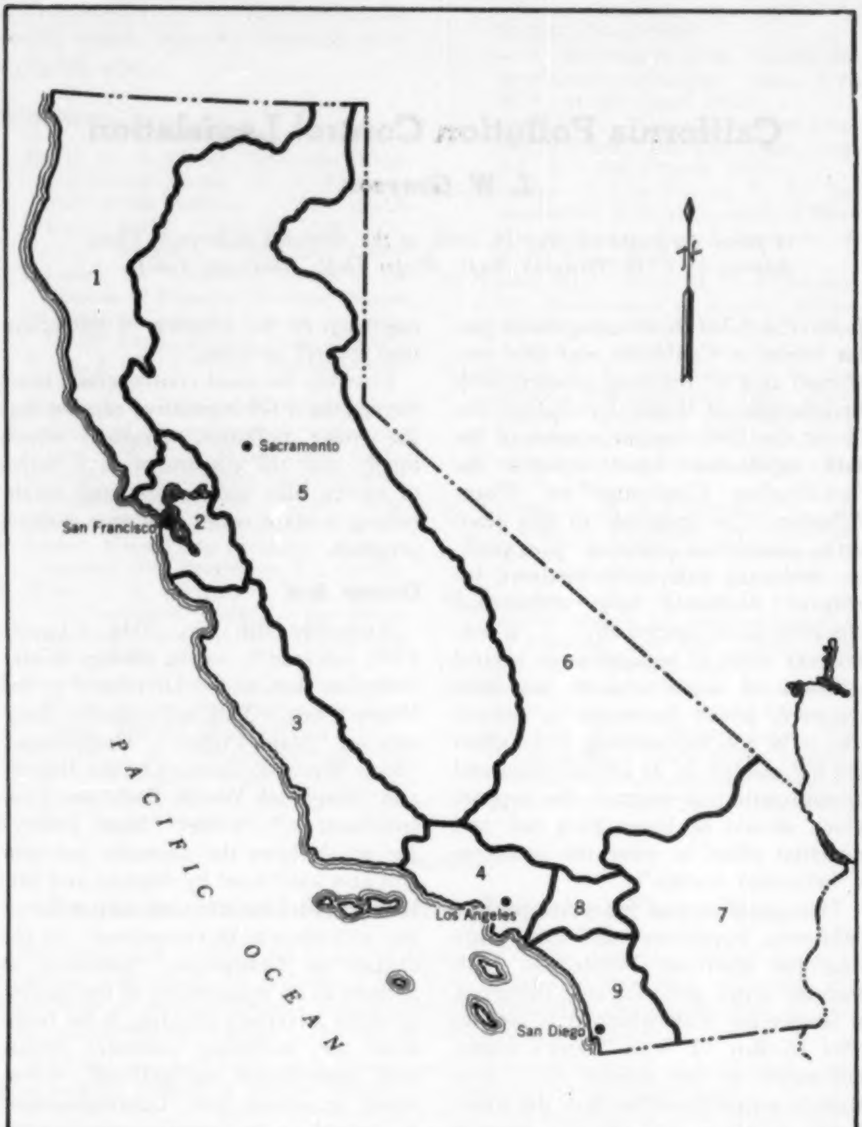

FIG. 1. Water Pollution Control Regions

of thirteen members, consisting of four state officers—director of public health, state engineer, director of natural resources and director of agriculture—or their nominees, and nine members appointed by the governor. Seven of these nine are to be qualified persons engaged in specified activities—produc-

tion and supply of domestic water, irrigated agriculture, industrial water use, production of industrial waste, public sewage disposal, city government and county government—with the two remaining members to be appointed at large. The board members serve four years, with staggered terms. The powers and duties of the board as set forth in the act are intended principally to establish, at a state level, a guiding hand for the control of water pollution.

Regional Boards

Chapter 4, "Regional Water Pollution Control Boards," divides the state into nine regions (Fig. 1) and creates a five-man board for each. The regions, which conform generally to the seven major water basins of the state, are:

1. The North Coastal Region—the watershed, draining into the Pacific Ocean, from the Oregon border to Marin County, north of San Francisco Bay
2. The San Francisco Bay Region
3. The Central Coastal Region—the area of drainage to the Pacific Ocean, extending south from Region 2 to approximately the western boundary of Ventura County
4. The Los Angeles Region—an area which, together with Regions 8 and 9, forms one of the major water basins of the state, the South Coastal Basin; Region 4 covers the Los Angeles metropolitan area, Los Angeles County and Ventura County to the west
5. The Central Valley Region—the great Central Valley of California
6. The Lahontan Region—all of the area east of Regions 4 and 5
7. The Colorado River Basin Region—the southeastern portion of the state, draining into the Colorado River and the Salton Sea
8. The Santa Ana Region—the entire watershed of the Santa Ana River
9. The San Diego Region—the area of drainage to the Pacific Ocean from the Santa Ana Region south to the California-Mexico boundary.

The personnel of the five-member boards, appointed by the governor to serve four-year staggered terms, are to represent each of the following activities: water supply, irrigated agriculture, industries producing industrial waste, municipal affairs and county affairs. In general, the powers and duties of the regional boards include the responsibility of coordinating action to prevent and control water pollution; development of self-policing in waste disposal programs; investigation of pollution sources, either directly or by directive to other agencies; and provision of long-range programming of pollution control within the region. The boards are empowered to conduct hearings and order such correction as their findings may indicate in matters of water pollution, as well as to cause court action to be instituted upon the failure to recognize board orders.

Other Legislation

Several additional bills passed by the 1949 state legislative session provide, among other things, financial assistance to municipalities and districts by loans from state funds (to be administered by the State Water Pollution Control Board) up to the full cost of sewage projects, if need be.

Certain changes in the state health and safety code were made to separate the problems of contamination and pollution as defined in the Dickey act; to direct the activities of the California Dept. of Public Health to those problems of contamination which create a hazard to, or threaten, the public

health; and to establish a procedure for abatement.

The California Div. of Water Resources is directed to make a continuous study of water quality and possible waste water reclamation in the state and to report annually to the legislature and regional boards, making recommendations on these matters, as well as on well drilling and sealing practices.

Finally, House Resolution 250 continued for a second interim period the life of the Water Pollution Committee for the further study of the problem of water pollution and the operation of these new laws.

Conclusion

The activities of the members of the California Section, A.W.W.A., are reflected in the several reports of the Water Pollution Interim Fact-Finding Committee (*2*) and in the Assembly and Senate journals. The unrecorded assistance of many other members was a factor in the extensive studies which resulted in the completed legislation.

The newly enacted laws will be applied by boards each including a well qualified water works man, usually a member of the A.W.W.A.

In the short period since November 1949, when the several board members were appointed, organization has been taking place, certain findings have been processed and the California Water Pollution Control Board Committee on Water Quality Criteria has completed a tentative report (*3*), dated March 2, 1950, which includes a method of analysis of waste disposal problems and a table showing the optimum and limiting values of water characteristics pertaining to each type of beneficial use (*see* p. 1147, *this issue*).

A different conception of the method to be applied for the control and correction of water pollution is now beginning to function in California, so that planned usage of the waters of the state and the expansion of cities, communities and industries may follow in an orderly manner. At the same time the protection of water supplies for agriculture, wildlife and the many other beneficial uses is expected to result.

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Editorial Note

On the following pages there are published, for the information of Journal readers, the New York State Water Pollution Control Board's "Classifications and Standards of Water Quality and Purity" (*see* p. 1137) and the California Water Pollution Control Board's "Progress Report on Water Quality Criteria" (*see* p. 1147), as examples of procedures which may be instituted in other states.

Classifications and Standards of Water Quality and Purity

New York State Water Pollution Control Board

A classification and standards system adopted on Oct. 25, 1950, by the New York State Water Pollution Control Board under authority given by the state legislature.

Rules Applicable to Tests or Analytical Determinations

PURSUANT to the authority contained in Article 6 of the Public Health Law, the New York Water Pollution Control Board hereby adopts the following rules:

Rule 1. In making any tests or analytical determinations of classified waters to determine compliance or noncompliance of sewage, industrial wastes or other wastes discharges with established standards, samples shall be collected in such manner and at such locations as are approved by the Board as being representative of the receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.

Rule 2. Tests or analytical determinations to determine compliance or noncompliance with standards shall be made in accordance with methods and procedures approved by the Board.

Classifications and Standards of Quality and Purity

Pursuant to the authority contained in Article 6 of the Public Health Law, the Board, having held public hearings as therein provided, hereby adopts the following classifications and standards of quality and purity for the waters of New York State:

Sec. 1—Definitions

The several terms, words or phrases hereinafter mentioned shall be construed as follows:

a. Best usage of waters as specified for each class shall be those uses as determined by the Board in accordance with the considerations prescribed by Section 109 of the Public Health Law.

b. Approved treatment as applying to water supplies means treatment accepted as satisfactory by the authorities responsible for exercising supervision over the sanitary quality of water supplies.

c. Source of water supply for drinking, culinary or food-processing purposes shall mean any source, either public or private, the waters from which are used for domestic consumption or used in connection with the processing of milk, beverages, foods or for other purposes which require finished water meeting U.S. Public Health Service Drinking Water Standards.

d. Fishing shall include the propagation of fish and other aquatic life.

e. Agricultural shall include use of waters for stock watering, irrigation and other farm purposes but not as source of water supply for drinking, culinary or food-processing purposes.

f. Tidal salt waters shall mean all tidal waters which are so designated by the Board and which generally shall have a chloride ion content in excess of 250 ppm.

Sec. 2—Conditions Applying to All Classifications and Standards

a. In any case where the waters into which sewage, industrial wastes or other wastes effluents discharge are assigned a different classification than the waters into which such receiving waters flow, the standards applicable to the waters which receive such sewage or wastes effluents shall be supplemented by the following:

"The quality of any waters receiving sewage, industrial wastes or other wastes discharges shall be such that no impairment of the best usage of waters in any other class shall occur by reason of such sewage, industrial wastes or other wastes discharges."

b. Natural waters may on occasion have characteristics outside of the limits established by the standards. The standards adopted herein relate to the condition of waters as affected by the discharge of sewage, industrial wastes or other wastes.

Sec. 3—Classes and Standards for Fresh Surface Waters

Class AA

Best usage of waters: Source of water supply for drinking, culinary or food-processing purposes and any other usages.

Conditions related to best usage: The waters, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, meet or will meet U.S. Public Health Service Drinking Water Standards and are or will be considered safe and satisfactory for drinking water purposes.

Quality Standards for Class AA Waters

Item	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits; taste- or odor-producing substances	None attributable to sewage, industrial wastes or other wastes
2. Sewage or waste effluents	None which are not effectively disinfected
3. pH	Range between 6.5 and 8.5
4. Dissolved oxygen	For trout waters, not less than 5.0 ppm.; for non-trout waters, not less than 4.0 ppm.
5. Toxic wastes; deleterious substances; colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food-processing purposes, or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

NOTE 1. In determining the safety or suitability of waters in this class for use as a source of water supply for drinking, culinary or food-processing purposes after approved treatment, the Water Pollution Control Board will be guided by the standards specified in the latest edition of "Public Health Service Drinking Water Standards" published by the United States Public Health Service.

NOTE 2. With reference to certain toxic substances as affecting fish life, the establishment of any single numerical standard for waters of New York State would be too restrictive. There are many waters which, because of poor buffering capacity and composition, will require special study to determine safe concentrations of toxic substances.

However, based on non-trout waters of approximately median alkalinity (80 ppm.) or above for the state, in which groups most of the waters near industrial areas in this state will fall, and without considering increased or decreased toxicity from possible combinations, the following may be considered as safe stream concentrations for certain substances to comply with the above standard for this type of water. Waters of lower alkalinity must be specially considered since the toxic effect of most pollutants will be greatly increased.

Ammonia or ammonium compounds	Not greater than 2.0 ppm. (NH_3) at pH of 8.0 or above
Cyanide	Not greater than 0.1 ppm. (CN)
Ferro- or ferricyanide	Not greater than 0.4 ppm. ($Fe(CN)_6$)
Copper	Not greater than 0.2 ppm. (Cu)
Zinc	Not greater than 0.3 ppm. (Zn)
Cadmium	Not greater than 0.3 ppm. (Cd)

Class A

Best usage of waters: Source of water supply for drinking, culinary or food-processing purposes and any other usages.

Conditions related to best usage: The waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to reduce naturally present impurities, meet or will meet U.S. Public Health Service Drinking Water Standards and are or will be considered safe and satisfactory for drinking water purposes.

Quality Standards for Class A Waters

Item	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto
2. Sewage or waste effluents	None which are not effectively disinfected

3. Odor-producing substances contained in sewage, industrial wastes or other wastes	The waters, after opportunity for reasonable dilution and mixture with the wastes discharged thereto, shall not have an increased threshold odor number greater than 8, due to such added wastes
4. Phenolic compounds	Not greater than 5 parts per billion (phenol)
5. pH	Range between 6.5 and 8.5
6. Dissolved oxygen	For trout waters, not less than 5.0 ppm.; for nontrout waters, not less than 4.0 ppm.
7. Toxis wastes; oil; deleterious substances; colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food-processing purposes, or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

NOTE. Refer to Notes 1 and 2 under Class AA, which are also applicable to Class A standards.

Class B

Best usage of waters: Bathing and any other usages except as source of water supply for drinking, culinary or food-processing purposes.

Quality Standards for Class B Waters

Item	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto
2. Sewage or waste effluents	None which are not effectively disinfected
3. pH	Range between 6.5 and 8.5
4. Dissolved oxygen	For trout waters, not less than 5.0 ppm.; for nontrout waters, not less than 4.0 ppm.
5. Toxic wastes; oil; deleterious substances; colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable for bathing, or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

NOTE. Refer to Note 2 under Class AA, which is also applicable to Class B standards.

Class C

Best usage of waters: Fishing and any other usages except for bathing or as source of water supply for drinking, culinary or food-processing purposes.

Quality Standards for Class C Waters

Item	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto
2. pH	Range between 6.5 and 8.5
3. Dissolved oxygen	For trout waters, not less than 5.0 ppm.; for non-trout waters, not less than 4.0 ppm.
4. Toxic wastes; oil; deleterious substances; colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

NOTE. Refer to Note 2 under Class AA, which is also applicable to Class C standards.

Class D

Best usage of waters: Agricultural or source of industrial cooling or process water supply and any other usage except for fishing, bathing or as source of water supply for drinking, culinary or food-processing purposes.

Conditions related to best usage: The waters will be suitable for fish survival; the waters without treatment and except for natural impurities which may be present will be satisfactory for agricultural usages or for industrial process cooling water; and with special treatment as may be needed under each particular circumstance, will be satisfactory for other industrial processes.

Quality Standards for Class D Waters

Item	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto
2. pH	Range between 6.0 and 9.5
3. Dissolved oxygen	Not less than 3.0 ppm.

4. Toxic wastes; oil; deleterious substances; colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to prevent fish survival or impair the waters for agricultural purposes or any other best usage as determined for the specific waters which are assigned to this class

NOTE. Refer to Note 2 under Class AA, which is also applicable to Class D standards.

Class E

Best usage of waters: Sewage or industrial wastes or other wastes disposal and transportation or any other usages except agricultural, source of industrial cooling or process water supply, fishing, bathing or source of water supply for drinking, culinary or food-processing purposes.

Quality Standards for Class E Waters

Item	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits	None attributable to sewage, industrial wastes or other wastes in sufficient amounts to interfere with navigation or cause a public nuisance as defined by the Penal Law
2. pH	Not lower than 5.0
3. Dissolved oxygen	Sufficient dissolved oxygen to prevent odor nuisances due to anaerobic decomposition, unless other effective means are used to control odors
4. Odor-producing substances	None in sufficient amounts to cause a public nuisance as defined by the Penal Law

Class F

Best usage of waters: Sewage or industrial wastes or other wastes disposal.

Quality Standards for Class F Waters

Item	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits	None attributable to sewage, industrial wastes or other wastes in sufficient amounts to cause a public nuisance as defined by the Penal Law
2. Dissolved oxygen	Sufficient dissolved oxygen to prevent odor nuisances due to anaerobic decomposition, unless other effective means are used to control odors
3. Odor-producing substances	None in sufficient amounts to cause a public nuisance as defined by the Penal Law

Sec. 4—Classes and Standards for Tidal Salt Waters

Class SA

Best usage of waters: Shellfishing for market purposes and any other usages.

Quality Standards for Class SA Waters

Item	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits	None attributable to sewage, industrial wastes or other wastes
2. Garbage; cinders; ashes; oils; sludge or other refuse	None in any waters of the Marine Dist. as defined by State Conservation Law
3. Sewage or waste effluents	None which are not effectively disinfected
4. Dissolved oxygen	Not less than 5.0 ppm.
5. Toxic wastes; deleterious substances; colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to edible fish or shellfish or the culture or propagation thereof, or which in any manner shall adversely affect the flavor, color, odor or sanitary condition thereof, or impair the waters for any other best usage as determined for the specific waters which are assigned to this class
6. Organisms of coliform group	The median M.P.N. value in any series of samples representative of waters in the shellfish growing area shall not be in excess of 70 per 100 ml.

Class SB

Best usage of waters: Bathing and any other usages except shellfishing for market purposes.

Quality Standards for Class SB Waters

Item	*Specifications*
1. Floating solids; settleable solids; oil; sludge deposits	None attributable to sewage, industrial wastes or other wastes
2. Garbage; cinders; ashes; oils; sludge or other refuse	None in any waters of the Marine Dist. as defined by State Conservation Law
3. Sewage or waste effluents	None which are not effectively disinfected
4. Dissolved oxygen	Not less than 5.0 ppm.
5. Toxic wastes; deleterious substances; colored or	None alone or in combination with other substances or wastes in sufficient amounts or at

other wastes or heated liquids	such temperatures as to be injurious to edible fish or shellfish or the culture or propagation thereof, or which in any manner shall adversely affect the flavor, color, odor or sanitary condition thereof; and otherwise none in sufficient amounts to make the waters unsafe or unsuitable for bathing or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

Class SC

Best usage of waters: Fishing and any other usages except bathing or shellfishing for market purposes.

Quality Standards for Class SC Waters

Item	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto
2. Garbage; cinders; ashes; oils; sludge or other refuse	None in any waters of the Marine Dist. as defined by State Conservation Law
3. Dissolved oxygen	Not less than 5.0 ppm.
4. Toxic wastes; oil; deleterious substances; colored or other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to edible fish or shellfish or the culture or propagation thereof, or which in any manner shall adversely affect the flavor, color, odor or sanitary condition thereof, or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

Class SD

Best usage of waters: Any usages except fishing, bathing or shellfishing for market purposes.

Quality Standards for Class SD Waters

Item	*Specifications*
1. Floating solids; settleable solids; sludge deposits	None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto

2. Garbage; cinders; ashes; oils; sludge or other refuse	None in any waters of the Marine Dist. as defined by State Conservation Law
3. Dissolved oxygen	Not less than 3.0 ppm.
4. Toxic wastes; oil; deleterious substances; colored or other wastes	None alone or in combination with other substances or wastes in sufficient amounts to prevent survival of fish life or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

Sec. 5—Classes and Standards for Underground Waters

Class GA

Best usage of waters: Source of water supply for drinking, culinary or food-processing purposes and any other usages.

Conditions related to best usage: The waters, if subjected to approved disinfection treatment if necessary, with additional treatment if necessary to reduce naturally present impurities, meet or will meet U.S. Public Health Service Drinking Water Standards and are or will be considered safe and satisfactory for drinking water purposes.

Quality Standards for Class GA Waters

Item	*Specifications*
1. Sewage or industrial wastes or ineffectively treated effluents; fecal matter, garbage, manure or other refuse	None within limiting distances of well, spring or infiltration gallery as specified in rules and regulations enacted under provisions of the Public Health Law for protection of a public water supply; none within limiting distances of well, spring or infiltration gallery as specified in decisions of Water Power and Control Commission; otherwise, if no limiting distances have been specified as indicated above, none within 200 ft. of a well, spring or infiltration gallery used as a source of a public water supply and none within 100 ft. of a well, spring or infiltration gallery used as a source for any other kind of drinking water supply unless a lesser or greater distance is approved, permitted or required by the local health authorities or the State Dept. of Health; otherwise none in such a way or in sufficient amounts to impair the waters for use as a source of water supply for drinking, culinary or food-processing purposes. Nothing in these specifications shall be construed as preventing the location of new wells under the jurisdiction of the Water Power and Control Commission.

2. Taste- or odor-producing substances	None attributable to sewage, industrial wastes or other wastes in sufficient amounts to make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food-processing purposes
3. Toxic wastes; deleterious substances; other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food-processing purposes, or impair the waters for any other best usage as determined for the specific waters which are assigned to this class

NOTE. In determining the safety or suitability of waters in this class for use as a source of water supply for drinking, culinary or food-processing purposes after approved treatment if necessary, the Water Pollution Control Board will be guided by the standards specified in the latest edition of "Public Health Service Drinking Water Standards" published by the United States Public Health Service.

Class GB

Best usage of waters: Source of industrial or other water supply and any other usages except as source of water supply for drinking, culinary or food-processing purposes.

Conditions related to best usage: The waters, without treatment and except for natural impurities which may be present, will be satisfactory for agricultural water supply or industrial process cooling water; and with special treatment as may be needed under each particular circumstance, will be satisfactory for other industrial processes.

Quality Standards for Class GB Waters

Item	*Specifications*
1. Toxic wastes; deleterious substances; other wastes or heated liquids	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to make the waters unsafe or unsuitable for any best usage as determined for the specific waters which are assigned to this class

Progress Report on Water Quality Criteria

California Water Pollution Control Board

A progress report presented on March 2, 1950, to the California Water Pollution Control Board by its Committee on Water Quality Criteria. Committee members include Gerald E. Arnold, Director, Water Dept., San Diego; Don McMillan, City Mgr., Pasadena; A. M. Rawn, Chief Engr. & Gen. Mgr., Los Angeles County Sanitation Dists.; and Frank M. Stead, Chief, Div. of Environmental Sanitation, California Dept. of Public Health. It is emphasized that this document is not an enacted law or regulation in California at present, but its publication for information purposes has been authorized by the California Water Pollution Control Board, which invites comment from interested groups. Comments or inquiries may be directed to the Executive Officer, State Water Pollution Control Board, 305 Financial Bldg., 927 Tenth St., Sacramento 14, Calif.

IN every area of varied topography and land and water use, there develops sooner or later a general pattern of water quality zones. This happens whether there is definite, conscious planning by governmental agencies or whether matters are left to take their own course, and whether conflicting interests adjust their differences by peaceful means or whether differences are settled in law courts. In a very general sense, the result is the same. In primitive catchment areas of little or no habitation and industry, streams remain largely in their natural state and quality of water is generally good. In the flat valley and plains areas, streams receive return drainage from irrigation and, at scattered locations, wastes from the sewer systems of towns and industries. The quality of water in streams in this area is moderately polluted, although not uniformly so, but is still salvageable for most uses.

Then, lastly, there are areas near the mouths of streams or near bays and harbors where wastes from cities and industries are concentrated, and pollution, of surface waters, at least, renders water unfit for those uses requiring water of a high degree of purity.

Such a pattern has already developed in California, and one might easily indicate these three zones roughly on a map of the state with respect to surface waters.

Because such patterns always seem to take shape, many states have built their programs of control of water pollution upon a basis of planned zoning of streams according to major uses (and abuses) of water, and within each zone have established water quality standards designed to be consistent with those uses.

Evaluation of Zoning Method

This method of regulation has certain very powerful advantages; it lets waste producing agencies and activities know very definitely where they stand, and it furnishes a simple basis for administration of a governmental control program. On the other hand, the

method has equally compelling objections, at least when applied to California, which cannot be lightly set aside. These objections are dealt with in the following paragraphs.

First of all, the uses of waters within a zone are by no means uniform throughout a zone. Take, for example, the coastal or bay waters. In some areas, such waters are inaccessible or by reason of temperature or currents unusable for any recreational purpose, while, in other areas, such waters may be used not only for swimming and bathing but also for shellfish culture or the fluming and processing of fish in fish canneries.

Secondly, the effects of pollution are not uniformly dispersed throughout a zone from a source of pollution but are restricted in geographical extent. Consequently, it is possible for highly exacting uses of water and sources of pollution of water to exist harmoniously in the same zone if properly related to each other geographically.

Thirdly, the successful program must recognize that the need for economical waste disposal is just as exacting as the need for protection of water quality for beneficial uses, for, lacking either, there can be no sound development. Waste treatment always consists of a combination of artificial treatment and utilization of resources of natural purification, and economy in waste disposal requires that maximum emphasis be placed on the latter. This is only possible if the requirements in the disposal of any waste take into account the relative geographical locations of the point of discharge and the points of beneficial usage so that full utilization may be had of the factors of natural purification in the intervening area.

Lastly, perhaps the greatest limitation to a zoning program is that it always tends to be fixed or permanent and does not lend itself to a program of reclaiming lost water quality or upgrading a degraded area.

Key Points

For these reasons, it is the firm conviction of the members of the Committee on Water Quality Criteria that a method of establishing the requirements of waste disposal in each region must be followed which will take into account the following key points:

1. The total interest in a water pollution control program encompasses *both* economical waste disposal and preservation of the beneficial uses of water.

2. Requirements as to waste disposal must recognize the *zone of influence* of wastes with respect to bacterial, biochemical, physical and chemical effects, and be only so severe as to protect some *beneficial use* of water (including simple aesthetic enjoyment) within such zones of influence.

3. Account must be taken of both the present and future planned quality of a receiving water in setting requirements for disposal of a waste.

4. Requirements in all cases must be reached by a logical analysis of all of the pertinent factors of a given problem rather than by simple reference to an arbitrary general rule, so that when examined judicially in court they will not be reversed.

5. The definition of "pollution" in the law is restricted to impairments of water quality which *unreasonably* affect such waters for beneficial use.

It is to be expected that some beneficial uses of water will suffer to some extent from disposal of wastes. In order to insure that such detrimental effects are not "unreasonable," account must be taken of the fact that every

beneficial use imposes two values on each of its water quality requirements: first, an optimum value, below which the use is not damaged to any significant degree by pollution; and, second, a maximum or limiting value, above which the beneficial use is, to all practicable purposes, inhibited or destroyed. There has been prepared and attached hereto a table showing the optimum and limiting values of water characteristics which pertain to each type of beneficial usage (Table 1).

6. Account must be taken of the fact that ground waters are of paramount importance in California, and that damage to ground waters is long-lasting if not permanent in nature, whereas surface waters recover rapidly when the source of pollution is removed. For this reason, risks of accidental pollution infrequent in occurrence that might be tolerated for surface waters must not be tolerated where the quality of ground waters is at stake.

Based on the foregoing considerations, there is hereunder set forth a method of analysis of waste disposal problems to be used as a basis of arriving at appropriate requirements pertaining to a waste which will prevent "pollution" as defined in the statute.

Method of Analysis of Waste Disposal Problems

PART I. *Comparison of the relative public and private "interest" in solving the waste problem with the "interest" in preserving the beneficial uses of water involved:*

Step 1. For the discharge in question, record the following information or facts:

a. Necessity of the disposal

b. Assessed valuation of the source of the waste (industry, city, etc.)

c. Number of people identified with the source of the waste (industry, city, etc.)

Step 2. Determine or estimate, for the waste and receiving body of water in question, the zones of influence with respect to:

a. Bacterial effects

b. Biochemical effects

c. Physical effects

d. Chemical effects

Step 3. Within the appropriate zone of influence, list the beneficial uses of water affected, and, for each separate beneficial use, list the following information:

a. Necessity for the use

b. Assessed valuation involved in the beneficial use (farm, city, industry, etc.)

c. Number of people identified with the beneficial use.

PART II. *Effects of discharge of wastes:*

Step 1. For the discharge in question, record the following data:

a. Liquid volume of waste, in gallons per day

b. Bacterial, biochemical, physical and chemical characteristics of the waste

Step 2. For that portion of the receiving body of water as will be intermixed with the waste, record the following data:

a. Volume of "flow," in cubic feet per second

b. Bacterial, biochemical, physical and chemical characteristics before discharge is made

c. Bacterial, biochemical, physical and chemical characteristics after discharge is made

Step 3. For each beneficial use affected by the waste, record the following data:

TABLE 1

Characteristics	Domestic Water Supply	Recreation			Wildlife Propagation		
		Bathing and Swimming		Boating and Fishing	Fish		Fowl Refuge
		Fresh Water	Salt Water		Fresh Water	Salt Water	
1. *Bacterial—per ml.*							
Coliform (opt.)	1.0	none	1.0	10	10	10	100
Coliform (max.)	50	1.0	10	100	100	100	1,000
2. *Organic—ppm.*							
B.O.D. (opt.)	none	5	5	10	10	10	10
B.O.D. (max.)	0.5	10	10	30	30	30	50
D.O. (opt.)	5	5	5	5	5	5	5
D.O. (min.)	2	2	2	2	3	2	2
Oil (opt.)	none	none	none	none	none	none	none
Oil (max.)	2	2	2	5	5	5	5
3. *Reaction*							
pH (opt.)	6.8–7.2	6.8–7.2	6.8–7.2		6.5–8.5	6.5–8.5	6.5–8.5
pH (critical)	6.6–8.0	6.5–8.6	6.5–8.6		6.5–8.5	6.5–8.5	6.5–8.5
4. *Physical—ppm.*							
Turbid. (opt.)	5	5	5	10	5	5	10
Turbid. (max.)	20	20	30	50	10	20	100
Color (opt.)	10	10	10	10	5	5	10
Color (max.)	30	30	30	50	10	20	100
Susp. solids (opt.)	10	50	50		10	10	50
Susp. solids (max.)	100	100	100		20	50	250
Float. solids (opt.)	none	none	none	none	none	none	slight
Float. solids (max.)		gross	gross	gross	gross	gross	gross
5. *Chemical—ppm.*							
Total solids (opt.)	500				1,000		
Total solids (max.)	1,500				5,000		
Cl (opt.)	250				1,000		
Cl (max.)	750				2,500		
F (opt.)	0.5-1.0						
F (max.)	1.5						
Toxic metals (opt.)	none	0.1	0.5		0.5	0.5	
Toxic metals (max.)	0.05	5	10		10	10	
Phenol (opt.)	1*	5*	50*	1	0.1	0.5	5
Phenol (max.)	5*	50*	1	10	1	5	25
Boron (opt.)							
Boron (max.)							
Na ratio† (opt.)							
Na ratio† (max.)							
Hardness (opt.)	100						
Hardness (max.)	250						
6. *Temp.*—°F. (max.)	60	65	65		60	60	
7. *Odor*‡ (max.)	N	N	N	M	M	M	M
8. *Taste*‡ (max.)	N	M	D		M	M	M

* Parts per billion.
† Per cent.
‡ Key: D—disagreeable; M—marked; N—noticeable; O—obnoxious.

Water Quality Requirements

Characteristics	Shellfish Culture	Irrigation			Industrial				Aesthetic Enjoyment
		Truck Garden Vegetables	Citrus Fruits	Other Crops	Food Processing		Cooling and Other		
					Fresh Water	Salt Water	Fresh Water	Salt Water	
1	1.0 5	1.0 10	10 100	100 100	0.1 1.0	1.0 3.0	1.0 10	10 100	
2	5 20				none 5	1 10	5 10	5 20	20 100
	5 2				5 1	5 1	3.0 1.0	3.0 1.0	5.0 1.0
	none 2	none 5	none 5	none 5	none 2	none 5	5 10	5 10	none 10
3	6.8–7.2 6.6–8.0	6.5–8.5 6.0–9.0	6.5–8.5 6.0–9.0	6.5–8.5 6.0–9.0	6.5–8.5 6.0–9.0	6.5–8.5 6.0–9.0	4.0–10.0 4.0–10.0	4.0–10.0 4.0–10.0	
4	5 50				5 20	5 50			50
	10 50				10 30	10 50			20 100
	10 100				10 50	10 100	50 150	50 150	
	none gross				none slight	none slight	none slight	none slight	slight gross
5		500 1,500	500 1,500	500 2,000	500 1,500		1,000 1,500		
		200 750	100 500	250 750	500 1,000				
		0.5–1.0 5							
	0.1	0.1 2.5			none 0.1	none 0.5			
	1* 10*	5* 20*			1* 10*	5* 50*			
			0.5 1.0	1.0 5					
		35–50† 80†	35–50† 75†	35–50† 80†			90† 90†		
							100 500		
6	70								
7	N	O	O	O	M	M	O	O	O
8	N				M	M			

* Parts per billion.
† Per cent.
‡ Key: D—disagreeable; M—marked; N—noticeable; O—obnoxious.

TABLE 2—*Analysis of Los Angeles Sewage Problem on Basis of "Pollution"*

Part	Waste: Sewage From Hyperion Outfall	Receiving Water: Santa Monica Bay		Beneficial Use: Bathing and Swimming
		Effects	Zone of Influence	
I	*Necessity* Huge volume of sewage requires it to be discharged into surface waters capable of diluting it so as to prevent septicity; reclamation may substantially reduce *average* volume but not *peak* volume requirements *Assessed valuation* Los Angeles City—$2,300,000,000 *Number of people* 1,800,000	Bacterial Biochemical Physical Chemical	Hermosa Beach to Santa Monica very limited Hermosa Beach to Santa Monica none	*Necessity* From standpoint of climate, accessibility, water currents, beach width and beach slope, this area is choice and impossible to duplicate elsewhere *Assessed valuation* Hermosa Beach to Santa Monica—$129,000,000 *Number of people* Los Angeles County (½)—2,000,000
II	*Volume of waste* 200 mgd. *Characteristics of waste* Mixed sewage and industrial waste from 2,000,000 people after screening only Coliform—100,000+/ml. Suspended solids—400 ppm.	*Volume of "flow"* 1,000+/1 dilution *Characteristics before discharge* Coliform—± 1/ml. No visible solids or grease *Characteristics after discharge* Coliform—10+/ml. Visible solids and grease		*Volume used* Entire stretch of beach *Optimum characteristics* Coliform—1+/ml. No visible solids or grease *Limiting values* Coliform—10/ml. Traces of solids and grease
III	*Cost to maintain limiting values* Primary treatment, chlorination and outfall—$30,000,000 *Cost to maintain optimum values* High-rate, activated-sludge treatment, outfall and chlorination—$43,000,000	*Conclusions* Both discharge and use are necessary Number of people involved in use justifies maintaining optimum conditions Cost of maintaining optimum conditions is not out of line with assessed valuation of city that must pay for treatment Provide complete treatment		*Beneficial use destroyed* Bathing and swimming and use of beach from Hermosa Beach to Santa Monica *Beneficial use damaged* Bathing and swimming for 5 miles north of Santa Monica and in Redondo Beach, as well as in area described above

a. Volume of water "used," in gallons per day

b. Optimum bacterial, biochemical, physical and chemical characteristics associated with the beneficial use

c. Maximum or *limiting* values of bacterial, biochemical, physical or chemical characteristics beyond which beneficial use would, to practical purposes, be destroyed.

PART III. *Balancing requirements of waste disposal against those of water use:*

Step 1. From the data in Steps 2 and 3 of Part II, tabulate the following:

a. Beneficial uses "destroyed" by the waste discharge

b. Beneficial uses damaged but not destroyed by waste discharge

Step 2. From the data in the preceding steps, compute the degree of "treatment" and cost of "treatment" to do the following:

a. Maintain at least limiting values of the quality characteristics required by each beneficial use (at point of use)

b. Maintain optimum values of the quality characteristics required by each beneficial use (at point of use)

Step 3. On the basis of the data in Steps 1 and 2 of this Part, and in view of the relative values shown in Part I, determine by the exercise of judgment:

a. Those uses for which *optimum* values of quality characteristics are to be maintained

b. Those uses for which values of quality characteristics exceeding the *optimum* but *not* exceeding the *limiting* are to be maintained

c. For those uses in Section *b* above, the degree by which the optimum values of quality characteristics may be exceeded to accomplish the best overall solution to the problem

Step 4. Translate the decisions reached in Step 3 of this Part into actual effluent requirements.

It is acknowledged that the foregoing method is a combination of *objective* and *subjective* procedures, but this is inescapable if the decisions are to be reasonable and judicial as provided in the statute.

[The committee report included, for illustrative purposes, an analysis of the Los Angeles sewage problem, reproduced here as Table 2.—*Ed.*]

Use of Alternating-Current Network Calculator in Distribution System Design

By M. V. Suryaprakasam, George W. Reid and J. C. Geyer

A contribution to the Journal by M. V. Suryaprakasam, Asst. Engr., Madras Govt., India; George W. Reid, Assoc. Prof., San. Eng., Univ. of Oklahoma, Norman, Okla. (formerly Assoc. Prof., Georgia Inst. of Technology, Atlanta, Ga.); and J. C. Geyer, Prof., San. Eng., Johns Hopkins Univ., Baltimore, Md.

SINCE the distribution network is the most expensive portion of a water supply system, it is economically sound practice to spend considerable effort in accurately determining its behavior (1). Generally, the development of a system does not follow a predictable pattern—it "just grows," like Topsy. Unfortunately, however, in any given grid of interconnected pipes, any addition to the system or any alteration in the performance of a component pipe will affect the operation of the entire system. Consequently, to obtain the maximum utilization of all available lines, the effect on the system of any addition or alteration ought certainly to be investigated. Most techniques employed at present to this end are, however, based on the theory of successive approximation and, as a result, are tedious and time consuming. Model studies of a system and its proposed alterations provide relatively rapid solutions, once the model has been constructed. Several different types of models, both hydraulic and electric, have been successfully built and used.

The authors have developed a method whereby a calculator, of which there are already more than 22 in operation, can be employed to arrive at a solution. Unfortunately, the a-c. network calculator relation between voltage and current, which are analogous to pressure and discharge, is a linear one, whereas the required relationship for water distribution is nonlinear. In order to compensate for this difficulty and to achieve acceptable results, a method of applying a correction factor to the linear reading has been developed and is reported in this paper.

The conventional method of solving hydraulic distribution system problems has involved the use of methods of successive approximations, such as the Hardy Cross system as modified by Doland (2–4). In such solutions, the relation between head loss, h, and discharge, Q, is:

$$h = rQ^n \quad \text{........Eq. 1}$$

in which n is an exponent whose value is dependent on the Reynolds Number and may vary between the limits of 1 (for laminar flow) and 2 (for turbulent flow). In the usual system, however, the value of n lies between 1.75 and 2.00, and in much of the work that has been performed previously, a value of 1.85 has been adopted. This is true in the Hazen-Williams formula, which is commonly employed. The value of r is a constant for each pipe, being de-

pendent on the size, length and roughness of the interior of the pipe. It is usually called the resistance factor.

Inasmuch as methods like that of Hardy Cross frequently require many lengthy series of calculations, several attempts have been made to solve such problems by the use of models, both hydraulic and electric. In the hydraulic models, pipe elements were usually represented by interconnected

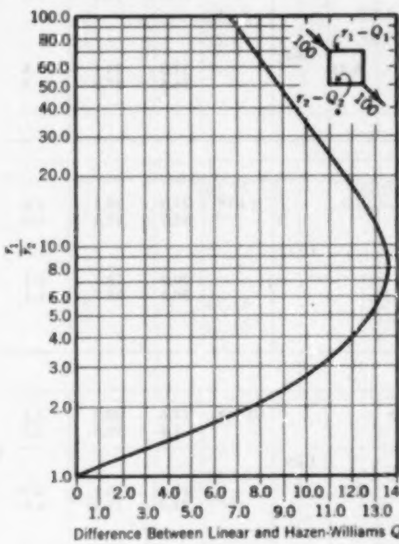

FIG. 1. Relation of $\frac{r_1}{r_2}$ and Difference Between Linear and Nonlinear Formulas

tubes wherein the pressure is measured by piezometers at the junctions and the discharge is measured volumetrically. The friction losses in these models were made to correspond to the prototype with suitable scale relationships by employing a variety of devices to lose energy. Gavett (5) used small, graduated orifices in the tube element and produced a relationship in which $n = 2$. Davis (6) used rounded-edge capillary tubes and reduced the n value from 2 to 1.85. Thomas (7) achieved the same effect by adjustable pinchcocks. These systems were small and were greatly affected by viscosity and temperature, as well as by a tendency to air-bind.

Network Calculator Studies

The development of the a-c. network calculator has given engineers a new tool to use in solving distribution system problems. This versatile instrument was primarily designed to facilitate the study of a-c. power systems. It provides a rapid method of solving problems otherwise solvable only with

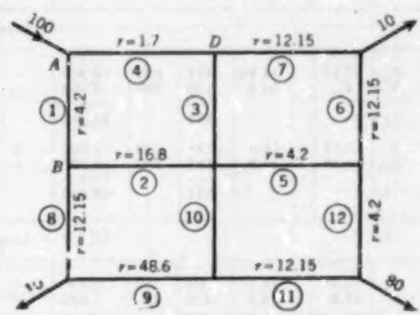

FIG. 2. Simple Hypothetical System

a great deal of difficulty by mathematical means. The network calculator contains all of the elements required to represent a power system: resistor-reactor circuits for transmission lines, transformers, loads and the like; condenser circuits for line-charging capacity and synchronous condensers; and voltage sources for system generators. All of these elements are easily adjustable in magnitude and are so arranged that they can be quickly connected into any form of network desired.

In the solution of a hydraulic distribution system problem, the network calculator is simply used to simulate the hydraulic system. Considering the

TABLE 1

Application of Corrections to Flow Quantities Obtained With Formula **h = rQ**

1	2	3	4	5	6	7	8		9	10	11	12	13
Element Serial No.	Resistance Factor r	Quantity Q, Calcd. With Formula $h = rQ$	rQ	$Q^{1.85}$	$rQ^{1.85}$	Sign of Correction to Be Applied	Equivalent Resistance of Each Arm		Ratio $\frac{r_1}{r_2}$	Correction to Be Applied	Corrected Quantity	Quantity Calcd. With Formula $h = rQ^{1.85}$	Difference Between Col. 11 and Col. 12
							r_1	r_2					
Loop No. 1													
1	4.2	38.0	159	850	3,570	+	13.6			5.5	43.5	42.2	1.3
2	16.8	21.3	356	290	4,870	+					25.9	21.4	4.5
			515		8,440				1.63				
3	12.15	−33.9	−414	685	−8,320	−		8.35			27.3	29.1	1.8
4	1.7	−62.0	−106	2,100	−3,570	−					56.5	57.8	1.3
			−520		−11,890								
Loop No. 2													
3	12.15	33.9	414	685	8,320	−		17.2		1.07*	27.3	29.1	1.8
5	4.2	40.4	170	950	3,990	−					33.7	32.4	1.3
			584		12,310				1.17				
6	12.15	−19.0	−231	230	−2,800	+	20.1				20.1	18.7	1.4
7	12.15	−29.0	−352	510	−6,200	+					30.1	28.7	1.4
			−583		−9,000								
Loop No. 3													
8	12.15	16.7	203	180	2,190	+	31.0			0.95†	17.6	20.8	3.2
9	48.6	6.7	326	33.7	1,640	+					7.6	10.8	3.2
			529		3,830				1.25				
10	12.15	−13.9	−169	130	−1,580	−		24.7			18.4	18.1	0.3
2	16.8	−21.3	−354	290	−4,870	−					25.9	21.4	4.5
			−523		−6,450								
Loop No. 4													
10	12.15	13.9	169	130	1,580	+	30.2			5.6‡	18.4	18.1	0.3
11	12.15	20.6	252	270	3,280	+					26.2	28.9	2.7
			421		4,860				2.9				
12	4.2	−59.4	−249	1,900	−7,970	−		10.4			53.8	51.1	2.7
5	4.2	−40.4	−170	950	−3,990	−					33.7	32.4	1.3
			−419		−11,960								

* $1.7 \times \frac{62.9}{100} = 1.07$.

† $2.5 \times \frac{38.0}{100} = 0.95$.

‡ $10.3 \times \frac{54.3}{100} = 5.6$.

basic hydraulic and electrical equations,

$$h = rQ^n \quad \text{........Eq. 1}$$

$$E = IR \quad \text{.........Eq. 2}$$

(in which E is voltage, I is amperage and R is resistance) it can be seen that a rough analogy exists between the two systems. Pressure or head is analogous to voltage, pipe resistance to electrical resistance, and discharge to cur-

TABLE 2

Method of Calculating Head Loss

Element No.	Resistance	Quantity of Flow as Corrected	$h = Q^{1.85}$	Adjustment to Head Values	Adjusted Head $Q^{1.85}$
Loop 1					
1	4.2	43.5	4,730	−690	4,040
2	16.8	25.9	6,960	−1,020	5,940
			11,690		9,980
3	12.15	27.5	−5,650	−825	−6,475
4	1.7	56.5	−3,060	−450	−3,510
			−8,710		−9,985
Loop 2					
3	12.15	27.5	6,475*		6,475
5	4.2	33.9	2,870	90	2,960
			9,345		9,435
6	12.15	19.9	−3,100	100	−3,000
7	12.15	29.9	−6,650	215	−6,435
			−9,750		−9,435
Loop 3					
8	12.15	17.6	2,420	1,390	3,810
9	48.6	7.6	2,080	1,195	3,275
			4,500		7,085
10	12.15	18.6	−2,700	1,550	−1,150
2	16.8	25.9	−5,940*		5,940
			−8,640		−7,090
Loop 4					
10	12.15	18.6	1,150*		1,150
11	12.15	26.2	5,150	1,510	6,660
			6,300		7,810
12	4.2	53.8	−6,850	2,000	−4,850
5	4.2	33.9	−2,960*		−2,960
			−9,810		−7,810

* Value corrected in previous loops and carried over.

TABLE 3

Comparison of Corrected Network Calculator Values and Hardy Cross Solution for Baltimore Network (See Fig. 3)

1	2	3	4	5	6
Element No.	Hardy Cross $h = rQ^{1.85}$	Calculator $E = IR$	Difference Between Col. 2 & 3	Calculator Corrected Col. 2 × $\phi \frac{r_1}{r_2}$	Deviation From Hardy Cross (Difference Between Col. 2 & 5)
1	21.61	20.08	1.53	20.24	1.37
2	19.01	17.48	1.53	17.64	1.37
3	10.73	11.74	1.01	10.53	0.20
4	9.57	10.58	1.01	9.37	0.20
5	7.49	8.50	1.01	7.29	0.20
6	0.76	1.00	0.24	0.36	0.40
7	1.24	1.00	0.24	1.64	0.40
8, 9	18.39	19.92	1.53	19.76	1.37
10	8.28	5.74	2.54	7.11	1.17
11	14.88	12.27	2.61	13.64	1.24
12	10.01	8.86	1.15	8.88	1.13
13	3.01	1.86	1.15	1.88	1.13
14	5.68	3.07	2.61	4.44	1.24
15	2.77	1.36	1.41	2.69	0.08
16	1.03	0.34	0.69	1.57	0.54
17	4.43	5.20	0.77	4.63	0.20
18	0.47	0.32	0.15	0.53	0.06
19	0.53	0.68	0.15	0.47	0.06
20	9.85	11.62	1.77	10.82	0.97
21	11.23	13.00	1.77	12.20	0.97
22	3.99	4.22	0.23	4.67	0.68
23	5.04	4.35	0.69	4.94	0.10
24	6.64	4.97	1.67	5.56	1.08
25	5.02	3.36	1.66	3.95	1.07
26	3.53	1.87	1.66	2.46	1.07
27	1.87	0.21	1.66	0.80	1.07
28	0.22	1.43	1.65	0.84	0.62
29	2.03	3.65	1.62	3.06	1.03
30	3.84	5.09	1.25	4.50	0.66
31	3.91	5.52	1.61	4.93	1.02
32	7.57	9.19	1.62	8.60	1.03
33	9.32	10.94	1.62	10.35	1.03
34	2.67	1.21	1.46	2.56	0.11
35	2.41	1.21	1.20	1.25	1.16
36	1.74	1.02	0.72	1.12	0.62
37	1.55	0.63	0.92	0.77	0.78
38	1.60	0.62	0.98	0.62	0.98

rent. Thus, if an electrical network is set up with the same connections as a pipe network (with the branch electrical resistances in proportion to the pipe resistances), the head loss and the analogous voltage drop will vary with the flow and current, respectively. The analogy is not an exact one, however, because the head-discharge relationship of flowing water is nonlinear, while the voltage-current relationship of an electrical circuit is linear. The analogy is

exact only in the case of laminar flow, where $n = 1$. The primary difficulty to date in applying the analyzer to distribution system problems has involved the devising of ways to overcome this nonlinear relationship.*

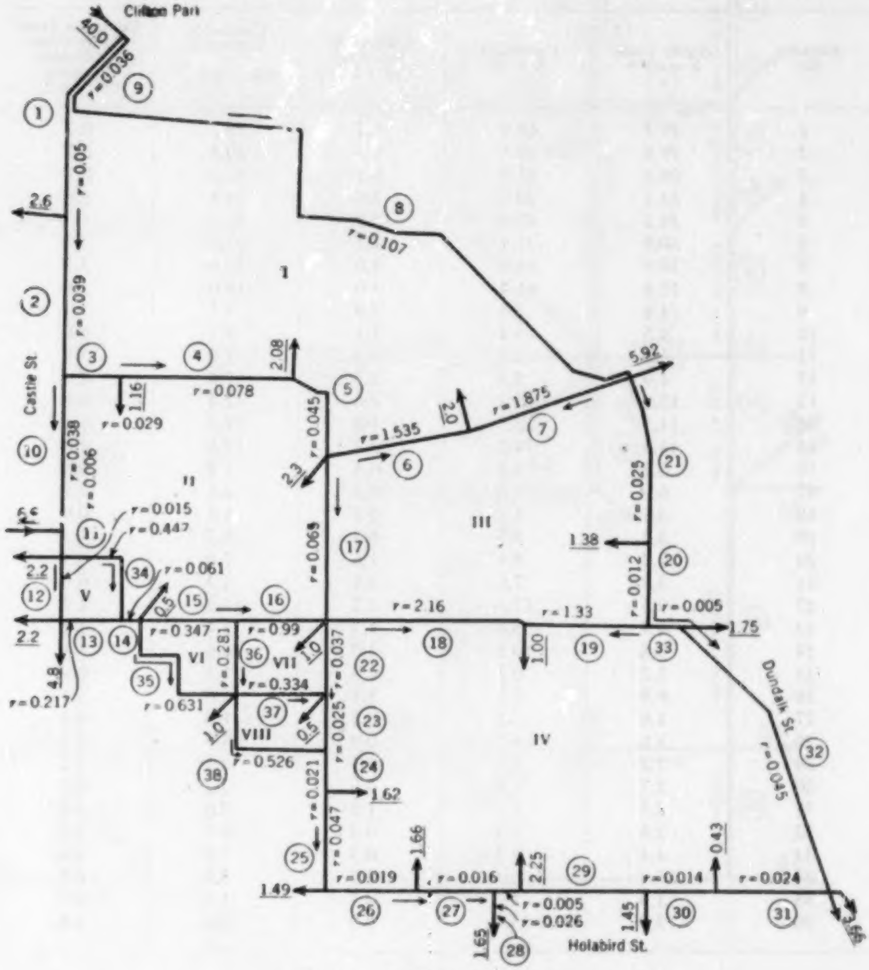

FIG. 3. Baltimore Network

The first investigation utilizing an electrical calculator for the solution of hydraulic problems was conducted by Camp and Hazen at Massachusetts Institute of Technology in 1934. They developed, mathematically, the analogy between the hydraulic and the electrical systems. The nonlinear relationship, referred to previously, was overcome by successively adjusting the re-

* An electric analyzer employing nonlinear resistors is described by McIlroy (11) in an article published since the present paper was prepared.

TABLE 4

Comparison of Corrected Network Calculator Values and Hardy Cross Solution for Robert and Co. Network (See Fig. 4)

1	2	3	4	5	6
Element No.	Hardy Cross $h = rQ^{1.85}$	Calculator $E = IR$	Difference Between Col. 2 & 3	Calculator Corrected Col. 2 $\times \phi \frac{r_1}{r_2}$	Deviation From Hardy Cross (Difference Between Col. 2 & 5)
1	59.2	68.9	9.7	58.5	0.7
2	29.8	20.5	9.3	30.5	0.7
3	58.2	67.9	9.7	57.5	0.7
4	23.2	20.6	2.6	24.8	1.6
5	34.2	48.0	13.8	32.4	1.8
6	30.8	37.9	7.1	27.1	3.7
7	20.9	16.9	4.0	23.6	2.7
8	15.4	11.4	4.0	18.0	2.6
9	4.4	1.5	2.9	7.7	3.3
10	4.5	3.4	1.1	3.7	0.8
11	4.0	1.7	2.3	7.9	3.9
12	4.9	3.2	1.7	7.8	2.9
13	12.6	15.2	2.6	12.4	0.2
14	11.5	12.5	1.0	12.8	1.3
15	14.8	14.5	0.3	12.8	2.0
16	4.2	3.8	0.4	4.8	0.6
17	6.9	7.0	0.1	4.1	2.8
18	3.5	4.2	0.7	4.4	0.9
19	5.2	5.5	0.3	6.7	1.5
20	7.2	8.8	1.6	7.0	0.2
21	3.7	7.6	3.9	4.3	0.6
22	9.5	12.2	2.7	11.2	1.7
23	4.3	3.0	1.3	5.4	1.1
24	9.5	10.5	1.0	10.6	1.1
25	5.2	6.1	0.9	4.3	0.9
26	6.9	5.5	1.4	5.8	1.1
27	1.6	2.1	0.5	1.8	0.2
28	5.6	4.7	0.9	4.8	0.8
29	1.2	1.6	0.4	0.1	1.1
30	2.7	1.8	0.9	2.7	0.0
31	2.5	1.2	1.3	3.6	1.1
32	2.5	2.9	0.4	1.5	1.0
33	4.4	4.7	0.3	5.0	0.6
34	5.4	6.1	0.7	5.9	0.5
35	1.9	1.2	0.7	1.6	0.3
36	3.9	3.0	0.9	3.1	0.8

sistances of the instrument, thus obtaining the required value of 1.85 for n (8).

In solving hydraulic problems by the Hazen and Camp method, a value for the flow is assumed and readings are successively adjusted to satisfy equations expressing the requirements of nonlinear resistance (Eq. 1):

$$h = rQ^{n-1}Q \quad \ldots\ldots\ \text{Eq. 3}$$

Camp and Hazen used Eq. 3, in which h corresponds to E, rQ^{n-1} to R and Q to I, to achieve this result. This method is essentially similar to the Hardy Cross method but is more rapid

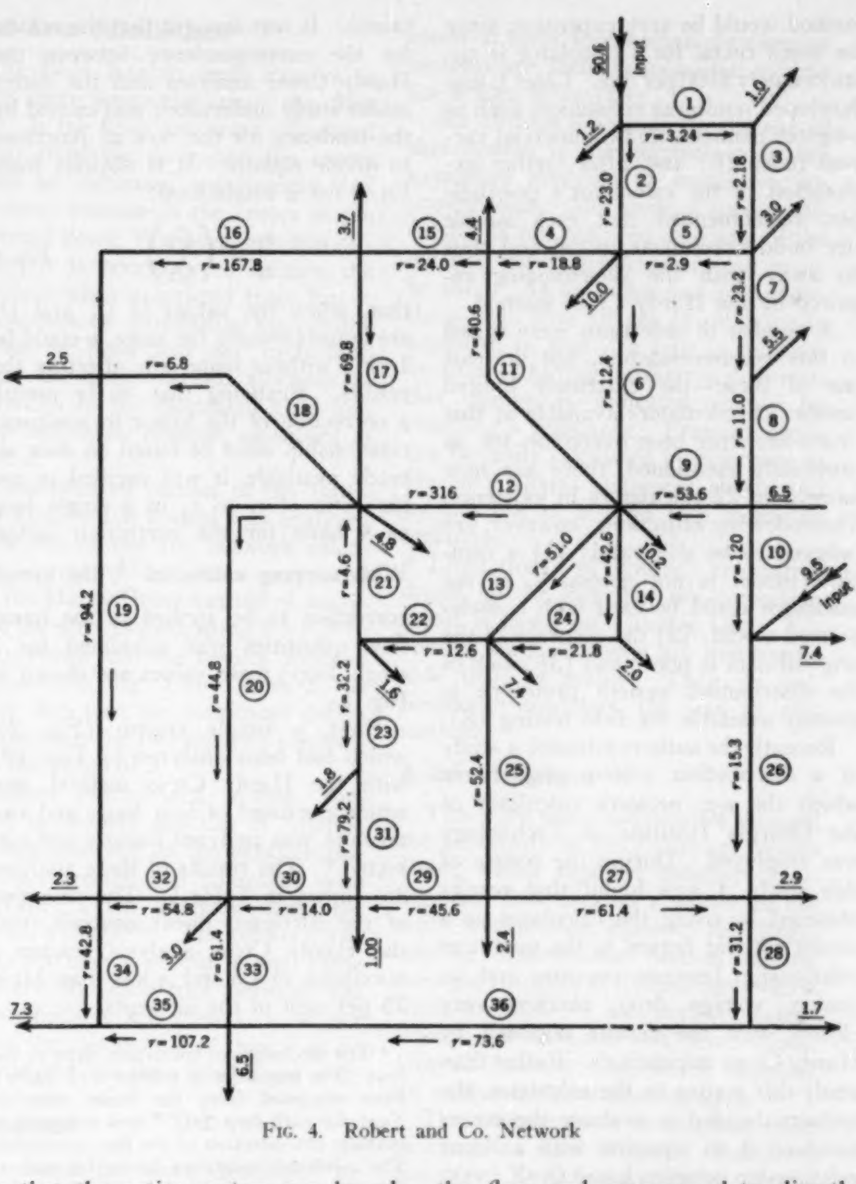

FIG. 4. Robert and Co. Network

in that the entire system can be adjusted at one time. The same number of successive approximations should be sufficient for each method.

One of the objectives of the work of Camp and Hazen was to obtain all of the flow and pressure data directly from the network calculator. They were successful in accomplishing this aim, but, again, only by a time-consuming method of trial-and-error adjustment. Consequently, the use of their

method would be very expensive, since the usual rental for a calculator is approximately $100 per day. Later Camp developed nonlinear resistances such as tungsten filaments and commercial vacuum tubes (6) and, after further exploration of the calculator's possibilities, recommended that each sizable city build a complete model and thus do away with the skeletonizing required by the Hardy Cross method.

A number of objections were raised to this recommendation, but at least one of these—the extremely limited number of calculators available at that time—has since been overcome, for, as previously mentioned, there are now more than 22 calculators in existence. The following objections, however, are believed to be still valid: [1] a complete model is not necessary, as the calculator could be used with a skeletonized model; [2] the accuracy of the original data is poor; and [3] much of the distribution system prototype is already available for field testing (8).

Recently the authors initiated a study of a distribution system problem in which the a-c. network calculator of the Georgia Institute of Technology was employed. During the course of this study it was found that results obtained by using the calculator as a model without regard to the nonlinear relationship between pressure and its analog, voltage drop, checked very closely with the results obtained by Hardy Cross calculations. Rather than study this matter on the calculator, the authors decided to evaluate the errors involved if an equation with a linear relationship between h and Q ($h = rQ$) is adopted instead of the nonlinear Hazen-Williams formula, to determine whether any reasonably simple correction, by the use of a rational method, could be applied to the values so obtained. It was thought that the reason for the correspondence between the Hardy Cross analyses and the direct model study undertaken was caused by the tendency for the flow at junctions to divide equally. It is obvious from Eq. 4 for a single loop:

$$\frac{r_1}{r_2} = \left(\frac{Q_2}{Q_1}\right)^n \text{......Eq. 4}$$

that, when the values of Q_1 and Q_2 are approximately the same, n could be 1 or 2 without materially affecting the results. Realizing that, to be useful, a correction of the linear to nonlinear relationship must b[e] [b]ased on data already available, it was decided to use the ratio of r_1 to r_2 in a single loop as a basis for the correction factor. With varying values of $\frac{r_1}{r_2}$, the actual correction to be applied to the linear flow quantities was calculated for a single loop; these values are shown in Fig. 1.

First, a simple system (Fig. 2), which had been analyzed by Fair (9) with the Hardy Cross method, and which consisted of four loops and two takeoffs, was analyzed linearly and corrected.* The results of these analyses are shown in Table 1. The deviation of the corrected linear analysis from the Hardy Cross analysis reaches a maximum of 4.5 and is less than 3.0 in 75 per cent of the elements.

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* The mechanics of correction were as follows: The quantities in column 3 of Table 1 were computed from the linear equation. Next, for each loop $\Sigma rQ^{1.85}$ was computed to evaluate the direction of the flow correction. The combined resistance factor for each of the arms was calculated by dividing ΣrQ for each arm by Q, and then the ratio $\frac{r_1}{r_2}$ was calculated. The flow correction to be applied to the linear result was then read from Fig. 1, and the corrected value entered in column 10.

Head Loss Calculations

The head loss in each element is often more important than the flow rate. If the head loss were calculated simply from the discharge, the errors would be increased significantly (12 per cent) because of the errors in the corrected flows. To overcome this difficulty, it is necessary to balance the head loss when calculated from Eq. 1. This is done by distributing the net difference in head loss for each loop among the loop's various elements in proportion to the calculated head loss of the individual element, as shown in Table 2.

A complicated section of the Baltimore distribution system was analyzed by the use of the a-c. network calculator, corrected and then compared with the Hardy Cross method of analysis for the same system, using $h = rQ^{1.85}$. The network and the results obtained are shown in Fig. 3 and Table 3. It can be seen that the maximum difference between the two analysis methods is on the order of 3.

Another complicated system, furnished by Robert and Co. of Atlanta, Ga., was analyzed on the network calculator, corrected and compared with the Hardy Cross analysis, using the equation $h = rQ^{1.85}$. The network and results are shown in Fig. 4 and Table 4. Here the difference between the two methods is less than 1 in 48 per cent of the elements, less than 2 in 80 per cent and less than 3 in 92 per cent.

Conclusions

A method has been developed by which a commercially available a-c. network calculator can be used with one setting and a correction factor, to produce results accurate within 5 per cent of total flow in the network. A 5 per cent error is well within the limits of error found when distribution systems are actually measured against the design flows (10).

An obvious advantage to the use of this system is the elimination of the expensive methods of successive approximation. Moreover, a special calculator is not required, and any of the existing network calculators can easily be used. As an additional advantage, the system once set can be quite easily adjusted, so that if a pipe is replaced by another having a different diameter, this change is indicated simply by changing a resistance. Pressure drops can be easily calculated by reference to Hazen-Williams alignment charts and by the use of a head loss balancing technique.

Limitations, of course, are introduced by the fact that the correction factor is based on a simple loop. Errors in small elements are more variable than in mains. They do not, however, invalidate the use of this method.

Acknowledgment

This work was made possible through the generosity of the Baltimore Water Dept., which supplied detailed drawings and flow data on a section of the city's distribution system; the Engineering Experiment Station of the Georgia Institute of Technology, which made available its a-c. network calculator; and Robert and Co., Cons. Engrs., Atlanta, Ga., which supplied an analyzed distribution system.

The authors wish to express their gratitude to Abel Wolman, Chairman, Sanitary Engineering Dept., Johns Hopkins University; Gerald A. Rosselot, Director, Engineering Experiment Station, Georgia Institute of Technology; J. S. Strohmeyer, Water Dept., Baltimore, Md.; R. A. Hickland, Robert and Co., Atlanta, Ga.; and H. P.

Peters and R. A. Strickland, operators of the a-c. calculator at the Georgia Institute of Technology.

The senior author, M. V. Suryaprakasam, presented this work in fulfillment of a requirement for the degree of master of science at Johns Hopkins University.

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Erratum

The "Tentative Standard Specifications for Trisodium Phosphate—5W1.60–T," published in the June 1950 Journal (Vol. 42, p. 601) contain an error. Paragraph (a) under Sec. 5C.1 (reagents for phosphoric anhydride determination), which reads:

> (a) 0.5*N* H_2SO_4 (standardize against NaOH which has been standardized against U.S. Bureau of Standards acid potassium phthalate using phenolphthalein as indicator)

should be removed from this section and substituted for the present paragraph (a) of Sec. 4C.1 (reagents for total-alkalinity determination). Sulfuric acid is not used in the determination of phosphoric anhydride.

1950 Conference—Philadelphia

THE Philadelphia Story was one of milestones: the first 2,000 registration; the first 8,000 membership; the 70th gathering of A.W.W.A.; and the 150th year of the Philadelphia water works. And with water supply drought-driven into public consciousness, this was the first year, too, that the Association's conference made a really big splash in the nation's news. All in all, it was a big meeting and an important one—its program an inventory of the vital interests not only of water works men but of an awakening public.

Featuring the five-day program, which ran from noon of May 21 through noon of May 26, were 15 technical sessions, 150 boothsful of manufacturers' exhibits, 19 inspection trips to 4 different plants, 2 technical motion picture sessions, exhibits of public relations material and amateur photography, a score or more of technical committee meetings and a dozen social events. With technical sessions, motion pictures, exhibits and committee meetings all taking place at spacious Convention Hall, members made a full day of it there, while their wives, headquartered at the Bellevue-Stratford Hotel, played, shopped and sightsaw all around Philadelphia and its historic environs.

In charge of the overall program was the Convention Management Committee, with the following crew, under the chairmanship of E. A. Sigworth:

Representing A.W.W.A.	*Representing W.&S.W.M.A.*
F. S. Friel	E. M. Jones
E. J. Taylor	T. T. Quigley

Ex Officio

A. P. Black, *President*	R. F. Hayes, *President*
H. E. Jordan, *Secretary*	A. T. Clark, *Secy.-Mgr.*
C. H. Capen, *Chm., Publication Com.*	

Businesswise, Charlie Capen was chief brewer of the technical potion as chairman of the committee which blended fifty subjects, a hundred speakers and fifteen sessions to produce a wonderfully well balanced program. The full schedule of papers presented (*see* pages 1170–72) and the written material which has been and will continue to be recorded in the pages of the Journal will give an idea of the scope and character of the discussions, though the valuable extemporaneous and spontaneous commentary cannot, of course, be reproduced. Those who attended, however, were most enthusiastic about such sessions as that on the Incodel program for water supply development in the New York–Philadelphia metropolitan area, that on water supply treatment for health benefits, that on safe yield from surface storage and that on pollution. But there wasn't a single session that wasn't most popular with a lot of people.

Businesswise, too, Art Clark's Exhibit Committee provided the biggest display of water works equipment ever assembled, some 90 exhibitors setting up shop in 150 booths across the main area of Convention Hall. There, before, between and after meetings, members dropped in to see, to want and to buy.

1950 CONFERENCE STATISTICS

Philadelphia Registration by Days

Day	Men	Ladies	Total
Sunday, May 21	485	131	616
Monday, May 22	799	180	979
Tuesday, May 23	182	13	195
Wednesday, May 24	120	5	125
Thursday, May 25	92	—	92
TOTALS	**1,678**	**329**	**2,007**

Geographic Distribution of Registrants

UNITED STATES & TERRITORIES

Alabama	26
Alaska	1
Arizona	4
Arkansas	3
California	65
Colorado	12
Connecticut	22
Delaware	17
Dist. Columbia	20
Florida	37
Georgia	40
Hawaii	5
Idaho	—
Illinois	118
Indiana	30
Iowa	31
Kansas	18
Kentucky	25
Louisiana	15
Maine	—
Maryland	58
Massachusetts	51
Michigan	35
Minnesota	29
Mississippi	2
Missouri	43
Montana	—
Nebraska	7
Nevada	—
New Hampshire	3
New Jersey	207
New Mexico	—
New York	304
North Carolina	31
North Dakota	3
Ohio	87
Oklahoma	9
Oregon	6
Pennsylvania	396
Puerto Rico	4
Rhode Island	20
South Carolina	16
South Dakota	2
Tennessee	22
Texas	34
Utah	2
Vermont	3
Virginia	40
Washington	6
West Virginia	9
Wisconsin	33
Wyoming	—

CANADA, CUBA & FOREIGN

Bermuda	1
Canada	41
Cuba	8
Dominican Republic	1
Egypt	1
Israel	1
Japan	2
TOTAL	**2,007**

Comparative Registration Totals—1941–1950

Year	Place	Men	Ladies	Total
1950	Philadelphia	1,678	329	2,007
1949	Chicago	1,593	374	1,967
1948	Atlantic City	1,348	356	1,704
1947	San Francisco	1,115	431	1,546
1946	St. Louis	1,303	214	1,517
1944	Milwaukee	1,185	171	1,356
1943	Cleveland	973	158	1,131
1942	Chicago	1,198	240	1,438
1941	Toronto	1,136	309	1,445

Win, Place & Show in Section Awards

Henshaw Cup		Hill Cup		Old Oaken Bucket	
Arizona	**72.5%**	**Arizona**	**393.9**	**California**	**.833**
Montana	64.0%	Chesapeake	66.6	New York	.663
Cuban	61.4%	Ky.-Tenn.	47.4	Southwest	.620

There, too, all A.W.W.A. missed Art Clark, his hat and his genius for friendliness, and all A.W.W.A. mourned his passing.

On the entertainment front, it was Tom Quigley's General Entertainment Committee which directed evening operations, beginning with a Sunday night "Movie Mixer" and running through the relatively formal president's reception and award nights to the uninhibited "Pretzel Panorama." As usual, though, it was the Annual Dinner and Dance that was considered the peak of playtime, featuring as it did not only presidents past and present, but a piano-playing M.C. named Bill Orchard, a mellow male chorus from the Rockwell Mfg. Co. and the return of long-lost minstrel George Hagetter.

To those receiving special mention must be added Casey Jones, who supervised "Local Arrangements" of all types, varieties and kinds; Austin Meehan, who bossed the hosts; and Larry Morgan, whose First Timers Host Committee took special care of those who were attending their first A.W.W.A. convention. And "Sig" Sigworth, Bert Taylor and Frank Friel didn't stop at their official jobs but pitched in everywhere to help everybody. A special niche must also be reserved for Mrs. Bert Taylor, whose work as head of the Ladies Entertainment Committee was done so well that a man had to make an appointment to see his wife, and to the "Missuses" Jones and Friel, who acted as first-assistant entertainers. And that's only the beginning. For a complete list of the people who did such wonderful work in making A.W.W.A. feel at home, reference should be made to the Pennsylvania portion of the geographic list of members in the Directory accompanying this issue.

Association Awards

Honorary Membership was conferred upon Jack J. Hinman Jr., of Iowa City, Iowa; John H. Murdoch Jr., of New York; and George W. Pracy, of San Francisco. The citations follow:

Jack J. Hinman Jr., Engineer, Iowa City, Iowa; a member of the Association since 1915; President 1930; Director, representing the Iowa Section, 1919–21; Secretary-Treasurer, Iowa Section, 1916–27; *a teacher whose leadership over many years has developed men for service in the water supply field; a loyal citizen who turned to his country's service during two great wars.*

John H. Murdoch Jr., Vice-President and Counsel, Water Service Co., New York; a member of the Association since 1930; *the possessor of an unusual combination of legal and executive ability who for many years has devoted himself to the advancement of the water supply industry.*

George W. Pracy, General Manager and Chief Engineer, Water Department, San Francisco; a member of the Association since 1915; President 1933; Fuller Award 1944; Secretary-Treasurer, California Section, 1920–22; Trustee 1923; Vice-Chairman 1924; Chairman 1925; *a prime mover in the organization of the California Section; a highly competent administrator whose active life has been spent in the public service of a great city.*

The John M. Diven Medal, awarded to the member whose services to the water works field during the past year are deemed most outstanding, was presented to Joseph P. Schwada. The citation follows:

JOSEPH P. SCHWADA, in recognition of the effort expended in directing a committee in the preparation of revised specifications for laying cast-iron water mains, and for his meticulous care, exacting attention to detail, and frank and courageous presentation of the problems involved.

The John M. Goodell Award, granted for the best paper published in the JOURNAL, was presented to the Special Committee on the Fluoridation of Public Water Supplies—composed of A. P. Black, Chairman; A. E. Berry; H. A. Faber; R. J. Faust; W. V. Weir; H. T. Dean, Consultant; and L. H. Enslow, ex officio—for "The Fluoridation of Public Water Supplies—Statement of Recommended Policy and Procedure," as published in the July 1949 JOURNAL (Vol. 41, page 575); the committee report having received wide recognition in the public health field and in the dental profession, and representing an important step in Association policy.

The George Warren Fuller Awards were presented to twenty-four men whose Sections had honored them during 1949 and 1950—the period from the 1949 Chicago Conference up to the beginning of the 1950 Philadelphia Conference—"for their distinguished service in the water supply field and in commemoration of the sound engineering skill . . . the brilliant diplomatic talent . . . and the constructive leadership of men . . . which characterized the life of George Warren Fuller." The list of awardees follows:

Alabama-Mississippi Section—HERBERT ANDREW KROEZE: For his many years of continuous and untiring effort in the development of public water works practices and leadership in water works engineering in the State of Mississippi.

Arizona Section—HELEN COWDEN ROTTHAUS: In recognition of her devoted service for the mutual advancement of the Bureau of Sanitation and the Section; for sound advice and hard work over many years, assisting the officers and committees.

California Section—JAMES RYERSON BARKER: For promotion and able leadership of successful conferences during his many years as Chairman of the Manufacturers Exhibits Committee; his untiring membership promotional activity and his years of service on the Section's Executive Committee as the manufacturers' representative.

Canadian Section—ALEXANDER BROCK MANSON: For efficient service in the management of a public utility commission; for long and highly valued aid to the Canadian Section; and for exemplary cooperation with, and assistance to, others in the water works field.

Chesapeake Section—EDWARD SCOTT HOPKINS: For his outstanding work in the field of sanitary chemistry, especially related to coagulation problems in water purification; for his untiring activities in the advancement of technical societies and his many contributions to water works literature.

Florida Section—WILLIAM ASA GLASS: For his many years of service in the field of private and public water utility operation and management; and for his continued interest in and support of the Florida Section.

Illinois Section—LEWIS BIRDSALL: For his continued interest in and cooperation with men engaged in water works operation; and for his services to the Section in official capacity during his many years of loyal membership.

Indiana Section—John Lawrence Ford: For devotion to the water works industry; constructive leadership in Section and Association affairs; counsel, encouragement and assistance to water works men; and for vision and initiative in the development of water works supplies and materials.

Kansas Section—Frank Alden Russell: For his outstanding service to his fellow citizens as engineer, educator, city official; booster for and officer of the Association; for his encouragement of research in the water works field; and his efforts on behalf of good and efficient municipal government.

Kentucky-Tennessee Section—Frank Clark Dugan: For his leadership in the organization of the Section and long service as its first Secretary; for his many years of outstanding service as State Sanitary Engineer for Kentucky and particularly his promotion of adequate and safe public water supplies.

Michigan Section—Louis Evans Ayres: In recognition of his tireless efforts and personal contributions toward the development of a rational basis for an equitable water rate structure; and his leadership of both the Section and Association committees on the subject.

Missouri Section—Warren Alvin Kramer: For his extraordinary ability in projecting into the water works profession in Missouri his own high standards of performance and integrity; for his technical assistance to the water plant operators; and for inspirational leadership in the organization of their efforts.

Montana Section—Joseph Michael Schmit: For his proven ability and leadership in the water works field and his long-active interest in the Montana Section.

Nebraska Section—John Connett Detweiler: In recognition of his twenty years of outstanding service as Manager of Water Operations of the Metropolitan Utilities District of Omaha; his long-term and constructive interest in A.W.W.A.; and for his services as the Section's first Director.

New England Section—Gordon Maskew Fair: For his able studies in the science of water supply and purification, which have resulted in improvement of the health and safety of the water-consuming public; and for his distinguished achievements as a teacher of sanitary engineering.

New Jersey Section—James Ernest Garratt: For his outstanding engineering services to the water works of New Jersey's largest city; and for his effective participation in the activities of the Section, including especially the chairmanship of its Program Committee.

New York Section—James McClure Wardle: In recognition of distinguished service to his Section; his helpful interest in water works schools of the state; his assistance to neighboring water systems; and the management of his own city's water works system so as to provide effective municipal service.

Ohio Section—Wallace Wilber Morehouse: In recognition of his pioneering in water works procedure; his generous sharing of operating knowledge; and his faithful and loyal service to the Association and the Ohio Section.

Pacific Northwest Section—Thomas Henry Judd: Because of his outstanding efforts to promote the interests of the Pacific Northwest Section and because of his inspirational and constructive leadership in many phases of water works management.

Pennsylvania Section—Howard Eugene Moses: For his long and distinguished career in the field of sanitary engineering; for his many contributions to the journals of the profession; and for his patient training, leadership of and continuing inspiration to young engineers.

Southeastern Section—Hugh Allen Wyckoff: In recognition of his many years of distinguished service to the water supply industry in developing technical leadership and scientific advancement; and for his active participation in annual courses for water supply operators.

Southwest Section—Albert Rosen Davis: For his long-term, conscientious and distinguished service to his city; his many years of active interest in the annual short school; and his loyal and untiring services to the Section.

Virginia Section—Howard Edward Lordley: For his proved ability and performance in the field of water purification and water works administration; and the many assignments fulfilled in the interest of the Virginia Section.

Wisconsin Section—Harold Leo Londo: For his efficient administration of his home city's water department; and for his effective and continuous services in promoting the best interests of the Section.

The Nicholas S. Hill Jr. Cup, awarded annually to the Section making the largest weighted gain in membership, was presented to the Arizona Section, which scored 393.9.

The Henshaw Cup, awarded annually to the Section having the greatest percentage of its members present at the Section's annual meeting, was also won by Arizona, scoring 72.5 per cent.

The Old Oaken Bucket, awarded to the largest Section in the A.W.W.A., went to the California Section, which has now won it eleven years in succession.

Schedule of Conference Papers and Reports

Open Session—10:00 A.M.—May 22, 1950

Committee on Water Works Administration....................W. R. LaDue, *Chairman*
Committee on Water Works Practice....................L. R. Howson, *Chairman*

Water Purification Division—10:00 A.M.—May 22, 1950

Committee Report—Specification Tests for Water Purification Chemicals....................
J. E. Kerslake, *Chairman*
Committee Report—Practical Loading Capacities of Water Treatment Plants....................
H. O. Hartung, *Chairman*
Committee Report—Water Conditioning Methods to Inhibit Corrosion....................
K. W. Brown, *Chairman*
Committee Report—Open-Air Reservoirs....................N. J. Howard, *Chairman*
Committee Report—Standard Methods for the Examination of Water and Sewage....................
R. L. Derby, *Chairman*
Panel Discussion—Future Plans of the Water Purification Division....................
R. C. Bardwell, C. R. Cox, N. J. Howard and Paul Weir

Water Works Management Division—2:00 P.M.—May 22, 1950

Panel Discussion—Bill Collection Stations in Large Cities....................*Led by* G. E. Arnold,
M. B. Cunningham, W. R. LaDue, E. C. Schwier and Paul Weir
Recording Customers' Use and Loss of Water....................E. Arthur Bell

Water Consumption in Multifamily Apartment Houses....................Edward Walasyk
Panel Discussion—Management Experience With Metering Multiple Dwellings............
Led by M. B. Cunningham,
W. G. Banks, J. C. Detweiler, W. A. Glass, B. E. Payne, H. B. Shaw
and G. J. Van Dorp

Water Purification Division—2:00 P.M.—May 22, 1950

Panel Discussion—Operating Control of Small Treatment Plants......*Led by* L. D. Matter,
J. H. Bartholomew, Francis Gosnell, C. R. Riddington and R. G. Yaxley
Prevention of Settlement of Iron..C. R. Henry
Further Studies of Colorimetric Hardness Titration..............J. D. Betz and C. A. Noll
Panel Discussion—Experiences in Addition of Fluorides to Drinking Water..................
L. A. Smith and J. C. Zufelt

General Session—9:30 A.M.—May 23, 1950

One Hundred Fifty Years' Water Works History..............................E. J. Taylor
Philadelphia's Plans for Water Supply Improvement......................M. G. Mansfield
Development Plans for the Delaware River:
Incodel's Relationship to Present Plans..J. H. Allen
The 1950 Interstate Report...Malcolm Pirnie
What the Plan Means to Pennsylvania..F. S. Friel

Water Purification Division—9:30 A.M.—May 23, 1950

Controlling Aquatic Growths in Impounding Reservoirs..........................E. W. Surber
Discussion..M. E. Flentje
Further Studies of High Filtration Rates..J. R. Baylis
Possible Hazards Resulting From Chemical Contamination of Water Supplies...............
C. W. Muehlberger
Discussion..R. L. Derby

General Session—Water Works Management Division—2:00 P.M.—May 23, 1950

Pennsylvania's Experience With Water Authorities..............................F. S. Friel
Long-Range Water Works Management as a Factor in Los Angeles Progress..S. B. Morris
Discussion..Charles Haydock
How Can the Nation's Water Resources Be Developed in an Orderly Fashion?.............
Gilbert F. White
Living With the Atom..N. R. Beers

Joint Session—Water Resources and Purification Divisions—9:30 A.M.—May 24, 1950

Adjustment of Water Treatment to Pollution Loading..........................H. A. Faber
Discussion................K. C. Armstrong, F. J. DeHooge, E. B. Evans, B. L. Strother,
A. R. Todd and D. B. Williams
Evaluating the Factors Contributing to Water Pollution..................L. L. Hedgepeth
Pollution Controls Versus Property Rights......................................J. H. Murdoch

Pipe Design—9:30 A.M.—May 24, 1950

Design of Steel Plate Pipe Flanges..R. E. Barnard
Design of Prestressed Concrete Steel Cylinder Pipe.........................H. F. Kennison
Design Standards for Large Steel Water Pipe......................................W. H. Cates
Tests of Prestressed Concrete Steel Cylinder Pipe.............................F. E. Seaman
Performance of Coal-Tar Enamel on Steel Water Pipe and Penstocks........G. E. Burnett

General Session—2:00 P.M.—May 24, 1950

Panel Discussion—The Philosophy of Supplementary Treatment of Public Water Supplies in the Interest of Group Health..
J. L. T. Appleton, A. P. Black, H. T. Dean and Joseph Shilen
The Magnitude of Industrial Demands for Process Water....S. T. Powell and H. E. Bacon
Desalting Sea Water for Domestic Use...W. W. Aultman
Discussion...C. H. Spaulding

Water Resources Division—2:00 P.M.—May 24, 1950

Committee Report—Water Use Laws of the Various States......Richard Hazen, *Chairman*
California's Water Pollution Control Laws................................L. W. Grayson
A Review of Pending Water Resources Legislation in Congress............G. E. Ferguson

General Session—Water Resources Division—9:30 A.M.—May 25, 1950

Panel Discussion—Safe Yield From Surface Storage Reservoirs—Eastern United States:
Introduction..Earnest Boyce
Overall Trends..C. G. Paulsen
Factual Information..W. B. Langbein
New England...G. W. Coffin
New York Metropolitan..........................E. J. Clark and Abraham Groopman
New Jersey..C. H. Capen
Ohio Valley...C. B. Burdick
Arkansas.....................................R. G. Kincaid and G. E. Hands
Summation...W. W. Brush

General Session—Water Works Management Division—2:00 P.M.—May 25, 1950

Public Fire Protection as a Factor in Rate Making..........................L. E. Ayres
Survey of Charges for Private Fire Protection..............................R. H. Ellis
Demand and Distance Factors in Rate Making..............................M. P. Hatcher
Panel Discussion—Report of Committee on Water Rates................*Led by* L. E. Ayres,
T. L. Amiss, C. H. Capen, R. H. Ellis, M. P. Hatcher, N. B. Jacobs,
A. P. Learned, H. F. Smith, S. K. Velliquette and Paul Weir

Water Resources Division—2:00 P.M.—May 25, 1950

Panel Discussion—Prospecting for Ground Water:
Geological Methods...R. M. Leggette
Geophysical Methods...C. A. Bays
Test Drilling..T. W. Thorpe
Pumping Tests..J. G. Ferris
Summation...J. J. Baffa
Preliminary Committee Report—Recommended Procedure for Plugging Abandoned Wells...
J. C. Harding *Chairman*
Discussion—Suggested Methods...O. J. Muegge
Committee Report—Division Planning.........................F. W. Kittrell, *Chairman*

Water Works Management Division—10:00 A.M.—May 26, 1950

Committee Report—Annual Report of Water Departments........M. P. Hatcher, *Chairman*
What Does It Cost to Provide Service to Special Class Customers?..............E. L. Bean
Committee Report—Water Use for Air Conditioning.............F. C. Amsbary, *Chairman*
Open Discussion—Air Conditioning...
F. C. Amsbary, E. L. Bean, L. L. Lewis and M. C. Smith

Papers Scheduled at 1950 Section Meetings

THERE follows a summary listing of papers scheduled for presentation at 1950 Section Meetings. The dates of the Section Meetings from 1946 to 1950 and locations for 1950 are given on page 1184. Section officers who were elected at meetings held during 1950 are listed on page iv of this issue. The programs are listed alphabetically by Sections, without regard to date of presentation.

Alabama-Mississippi Section—October 11–13, 1950

Mobile's Big Creek Development.....H. E. Myers
Public Relations.....Harry E. Jordan
 Discussion.....T. Leon Maxwell
 Discussion.....William E. Hooper
General Maintenance of Small Water Meters.....Stanley Sweeney
 Discussion.....James L. Mattox
Wells.....H. D. Shope
 Discussion.....Tom Collins
Panel Discussion—Defense Planning.....*Led by* Arthur N. Beck
Financing Water Works Construction.....W. L. Gilmer
 Discussion.....George J. Roark
 Discussion.....Donald Mills
Problems in Overloaded Distribution Systems.....H. F. Wiedeman
 Discussion.....C. D. Lamon
 Discussion.....W. U. Quinby
Stream Sanitation.....L. A. Young
 Discussion.....J. C. Clarke
 Discussion.....H. A. Kroeze

Arizona Section—March 31–April 2, 1950

Address of Welcome.....*Mayor* Clayton Hakes
Panel Discussion—Safety Practices.....John A. Carollo, John Rauscher and Dario Travaini
Effect of Home Kitchen Disposal Units on Domestic Sewage Treatment Plants...R. E. Zink
Ground Tank Installation.....Guy A. Rhoads
Every Drop to Drink.....*A Motion Picture*
Valve and Fire Hydrant Standards.....John Rauscher and Jim Hennessy
Panel Discussion—Ground Water Recharging.....*Led by* Sam F. Turner
Submersible Motor Pump.....*A Motion Picture*
Standards for Reclaimed Water—A Progress Report.....George W. Marx
Should a Municipal Water Supply Encourage Unlimited Use of Water by Consumers?......
R. Gail Baker and Byrl D. Phelps
Operators' Roundup.....*Led by* John Rauscher
Design Factors in Sewage Treatment.....Harold W. Yost
Latest Developments in Corrosion-resistant Paints and Linings.....Russell Jackson

Arizona Section—November 30–December 2, 1950

Purchasing Material.....H. R. LaFortune
Cement Joints, Their Cost, Experience and Acceptance.....M T. Bramman
Panel Discussion.....*Led by* G. E. Arnold
 Utilities and the Consulting Engineer.....Leigh O. Gardner
 Utilities and the Law.....Evo DeConcini
 Management-Employee Relations in a Utility.....John T. Kimball
 Utilities and the Contractor.....Warren Hunter
 Utilities and the Manufacturer.....J. Kenneth Potts

Mobile Equipment in Sewer Maintenance.......................*A Motion Picture*
Cross Connections.......................Charles E. Trygg
The Role of Water Works Organizations in Disaster Relief Operations.....Harvey Ludwig
Panel Discussion.......................*Led by* H. Arthur Price
Maintenance of Equipment.......................Dario Travaini
Mobile Phone Communications.......................M. J. Shelton
Sand Traps in Domestic Water Supplies.......................Tom Nesbitt
The Importance of Consumer Metering.......................George Sopp
Lubrication of Domestic Water Pumps.......................Harold W. Yost

California Section—October 24–27, 1950

Address of Welcome.......................*Mayor* Harley E. Knox
Response.......................E. A. Reinke
Features of the San Diego Water System and Description of the New Alvarado Filtration Plant.......................Gerald E. Arnold
Review and Discussion of the California Section, A.W.W.A., Proposed Water Service Regulations.......................*Led by* William C. Welmon
Do We Have Accounts or Records?.......................Frank Twohy
Discussion.......................Roy M. Sedgwick
Discussion.......................R. A. Campbell
How California Cities Are Authorized to Issue Water Revenue Bonds..Stephen B. Robinson
The Design of Water Rate Structures.......................R. L. Gresham
Engineered Supervision.......................W. J. Stephens
In-Service Training.......................W. M. Harrison
Photographing Water Wells.......................Claude Laval Jr.
Water System Permits.......................Henry J. Ongerth
Panel Discussion—Steel Tank Protection.......................*Led by* William C. Renshaw
Cold Paints.......................H. A. Harris Jr.
Coal-Tar Enamel.......................John W. Clay
Cathodic Protection.......................Harry J. Keeling
Mobile Phone Communications:
Three-Way Radio.......................Nat J. Kendall
Car Telephones.......................M. J. Shelton
Power Rate Selection and Off-Peak Use of Power Facilities.......................Percy P. Pine
Lining Large Pipes in Place.......................Robert C. Sargent
Control of Growths in San Diego Reservoirs.......................James H. Keller
Waste Water Reclamation Studies at Lodi.......................Ray V. Stone Jr.
Diatomite Filtration.......................Joseph M. Sanchis
Round Table Discussion—Operation of Purification Plants.......................
Martin F. Tillman, Henry C. Myers and J. N. Spaulding
California's Water Pollution Control Program—Progress and Procedures..Vinton W. Bacon
Panel Discussion—Future Water Supply, Requirements and Availability:
Domestic and Industrial Requirements.......................C. C. Elder
Agricultural Requirements.......................Harry F. Blaney
Availability of Water.......................C. B. Meyer
The Implications of Radioactive Materials in the Water Works Field..Birchard M. Brundage
Operation Crossroads.......................*A Motion Picture*
Water Works Disaster Committee Report.......................John S. Longwell

Canadian Section—April 3–5, 1950

A River Crossing at Peterborough.......................R. L. Dobbin
Guided Discussion—Miscellaneous Water Works Problems.......................*Led by* G. H. Baker
Willing Water—Healthy or Anemic?.......................L. R. Howson
Discussion.......................W. Storrie
Discussion.......................W. D. Hurst
Installation and Maintenance of Valves in a Water Works System..........R. Y. Dorrance
Discussion.......................A. U. Sanderson

Guided Discussion—Installation and Maintenance of the Larger Water Meters............. *Led by* I. P. MacNab
Modern Water Clarification Processes.................................G. H. Strickland
Sterilization With Chlorine Dioxide at Niagara Falls, N. Y...............Fred V. H. Piper
Guided Discussion—Water Storage Needs in Water Works Operation...................... *Led by* T. J. Lafreniere
Guided Discussion—Problems of Small Water Works Systems.........*Led by* M. W. Rogers
Development and Maintenance of Underground Water Supplies...........T. L. McManamna
Guided Discussion—Problems and Procedures in Handling Water Accounts................ *Led by* R. Harrison

Chesapeake Section—November 1–3, 1950

Address of Welcome..*Mayor* James F. Hearn
Response..Clarke Gardner
Ground Water Resources of the Chesapeake Bay Area:
West of Bay..Robert R. Bennett
East of Bay...William C. Rasmussen
Control of Public Water Supplies by the Delaware State Board of Health.................. Donald K. Harmeson
Panel Discussion—Water Wells...............................*Led by* Albert G. Fiedler
The Development of a Ground Water Supply..........................Paul Schweitzer
Selection and Description of Deep Well Pumps.......................Henry A. Gropp
Water Well Abuse...John C. Geyer
Rehabilitation of Wells..W. J. Sloan
The Need for a Reequipment Policy..................................W. Victor Weir
General Meter Symposium:
Selection..John M. Jester
Installation and Maintenance..................................Francis W. Buschman
Billing and Reading..Marvin W. McKay
Adequacy and Reliability in Water Supply Systems From the Fire Protection Standpoint.... Kenneth J. Carl
Panel Discussion—Air-Conditioning Demands......................*Led by* R. C. Willson
Hagerstown, Md...R. C. Willson
Washington Suburban Sanitary Commission...........................Harry B. Shaw
Baltimore, Md...Karl H. Schamberger Jr.
Washington, D.C..Roy L. Orndorff
Trends in Air-Conditioning and Refrigeration Industry..................R. A. Gonzalez
Ion Exchange for Water Treatment..................................Edward B. Showell
Medical Bacteriology or Interpreting Water Supply to the Public...........Miriam S. Shane
Civil Defense Significance to Water Systems........................Gordon E. McCallum

Cuban and Florida Sections—November 12–15, 1950

Address of Welcome...Fred D. Rankins
Responses...S. K. Keller and M. J. Puente
Sewage Federation Activities...B. F. Borden Jr.
A.W.W.A. Activities...Harry E. Jordan
Chlorination—The First Fifty Years...................................Harry A. Faber
Discussion...Linn H. Enslow
Cuban Section Is Ten Years Old....................................Laurence H. Daniel
Cuban Water Rates—Cuban Section Committee Report...............................
Panel Discussion—Defense Planning Progress in Florida..............*Led by* David B. Lee
Panel Discussion—Fluoridation...................................*Led by* S. W. Wells
Waste Water Treatment...V. J. Calise
Industrial Wastes...F. S. Gibbs
Panel Discussion—Sewage and Industrial Wastes.................*Led by* John Wakefield
Pulp Mill Wastes...Harry Gehm
Panel Discussion—Water Supply Problems in Florida.................*Led by* A. P. Black
Trenton Cleans Its Water Mains...................................*A Motion Picture*
Water Supply Today and Tomorrow....................................Linn H. Enslow

Illinois Section—April 12–14, 1950

Public Relations at Work....Horace R. Frye
A Method of Keeping Water Department Revenues for Water Department Uses..H. S. Merz
Fluoridation in Sheboygan and Wisconsin....Jerome C. Zufelt
Overhaul and Repair of Oscillating Piston Meters....R. Z. Hague
Overhaul and Repair of Nutating Disk Meters....Henry De Pagter
Distribution System Round Table:
  Mains....Dewey W. Johnson
  Valves and Hydrants....George W. White
  Main Cleaning and Lining....James Closser
  Elevated Tanks....Edward E. Alt
  Fire Demands....George Tatnall
  Water Quality Deterioration....J. D. Vaughn
  Fire Department Requirements....Anthony J. Mullaney
Atomic Wastes and Water Quality....W. A. Rodger
Mutual Aid on Water Quality Matters....Armon Lund
Purification Round Table—New Developments:
  Coagulation....John R. Baylis
  Filtration....A. E. Anderson
  Disinfection....C. C. Abplanalp
  Taste and Odor Control....C. C. Larson
  Softening....Gerald L. Davis
Rockford Ground Water Situation....H. M. Smith
Water Shortages—A Realistic Approach to Their Correction....Vail H. Moore
The Submission of Plans and Specifications to the State Department of Public Health for Water Works Improvements....H. A. Spafford
What Is the Future for Public Water Supplies for Very Small Communities?....
Ralph Wilson and Vincent Newman

Indiana Section—April 26–28, 1950

Preparation of Water for Filtration....John R. Baylis and H. H. Gerstein
  Discussion....H. J. Draves
  Discussion....O. A. Newquist
Chlorine Dioxide Treatment....R. W. Aston
  Discussion....Richard Coote
  Discussion....Lawrence J. Killion
Pensioning of Water Works Employees....Ross Teckemeyer
  Discussion....Paul E. Congdon
  Discussion....H. C. Powers
Licensing of Water Works Employees....Jack Gordon
  Discussion....B. A. Poole
  Discussion....Louis A. Geupel
Elements of a Rate Case From an Accounting Viewpoint....Carl Cecil
  Discussion....Edgar C. Kruse
  Discussion....Max Stearns
Insurance—Public Liability and Workmen's Compensation Coverages....Harry Von Burg
Inserting a 36-in. Valve Under Pressure....G. J. Manahan
Defects of Your Water Distribution System....M. P. Susanke
  Discussion....Clyde E. Williams
  Discussion....Paul J. Kleiser
Valve and Hydrant Maintenance....H. W. Niemeyer
  Discussion....Glen Garman
  Discussion....M. H. Schwartz

Iowa Section—October 26–27, 1950

Address of Welcome....*Mayor* A. B. Chamber
Response....George Nelson
Sterilizing New Water Mains....M. K. Tenny

Panel Discussion—Taste and Odor Control .... *Led by* Leo Louis
Discussion .... N. S. Chamberlin
Discussion .... John Matarese
Discussion .... F. Filicky
Discussion .... Victor Hann
Reclamation and Conservation of Ground Water Supplies .... G. H. Hershey
Panel Discussion—Office Methods and Equipment .... *Led by* M. E. Driftmier
Discussion .... C. E. Lapham
Discussion .... J. F. Dondell
Construction Trends in the Water Works Field .... Vernon Kneer
Procedure for Bond Issues .... William L. Hassett
Experience With Cement-Asbestos Pipe .... W. R. Gelston
Question and Answers .... *Led by* P. F. Morgan, Paul Houser, Ted Lovell, Gilbert Kelso and Leo Louis

Kansas Section—April 19–21, 1950

Address of Welcome .... *Mayor* Lloyd W. Price
The Salina Water System .... E. J. Allison
Water Departments and Classification of Public Fire Protection .... E. N. Harsha
Salaries and Water Works Personnel .... John G. Stutz
Observations on the Water Works Rate Structure .... F. A. Russell
Pure Water—Our Search for It .... Dwight F. Metzler
The Effect of Industrial Wastes on Sewage Treatment at Topeka .... D. B. Kissinger
Needed Legislation for Pollution Abatement in Kansas .... Paul R. Shanahan
The Value of Clean Waters to Kansas Fishermen .... Harry F. Lutz
Water Works Potpourri Forum .... *Led by* Fred D. Diehl
Keeping Wells Operating .... E. S. Jungmann
Collecting the Bill .... Ray Lundy
Distribution Systems .... James D. Barker
Public Relations .... Morris B. Willis
The Kansas River Basin Water Pollution Investigation .... Paul D. Haney
Panel Discussion—It's Different Here .... *Led by* Robert S. Millar, H. H. Kansteiner and V. E. Hougland

Kentucky-Tennessee Section—October 23–25, 1950

Address of Welcome .... Thomas H. Allen
Response .... E. E. Jacobson
A Look Into the Future .... A. P. Black
Pollution Control Activities of the Ohio River Water Sanitation Commission .... Edward J. Cleary
The U.S. Public Health Service Stream Sanitation Program .... W. W. Towne
Financing Municipal Utilities .... Lincoln E. Caffall
Services of the United States Geological Survey .... W. R. Eaton
Development of Water Supply Sources:
Well Supply .... Justin Davis
Surface Supply .... James K. Latham
Chemical Treatment of Water:
Factors Affecting Coagulation .... W. H. Lovejoy
Chlorination of Water .... John J. Quinn
Fluoridation of Water .... J. Wiley Finney Jr.
Corrosion Control .... Earl T. Mitchell
Water Distribution Practices:
Construction of New Works .... C. H. Bagwell
Operating Problems .... Howard D. Miller
Water Waste Surveys .... J. Edward Thacker
Office Procedures:
Billing Practices .... B. E. Payne
Public Relations .... M. L. Brickey

Water Pumping Equipment .... J. R. Fleming
Design of New Memphis Water Treatment Works .... D. L. Blackwell and Robert Brown
The Memphis Water Supply .... Frank C. Pentecost

Michigan Section—October 25–27, 1950

Address of Welcome .... *Mayor* Albert E. Cobo
News of the Field .... John E. Vogt
Relationship of Water Works to General City Administration .... John Huss
Discussion .... H. E. Allen
Discussion .... H. L. Keinath
Discussion .... L. E. Ayres
Uniform Accounting and Reporting for Municipal Water Utilities .... Philip R. Potter
Discussion .... Earl E. Norman
Discussion .... H. H. Caswell
Discussion .... Larry Schram
Operation and Maintenance of Wells .... Donald C. Egbert
Well Operation and Maintenance Experiences at Lansing .... Claude Erickson
Selection of Well Pumps .... George E. Hubbell
Maintenance of Well Pumps .... Harry W. Thomas
Elements of Rapid Sand Filter Design .... Richard Hazen
Experiences With Rapid Sand Filter Maintenance ....
John F. Dye, Robert Hansen and Howard Rafter
Some Aspects of the Detroit Metropolitan Area Water Supply .... Laurence G. Lenhardt
Elevated Structures and Civil Aeronautic Regulations .... Wayne A. Colby
Civilian Defense as Related to Water Works .... R. J. Faust
Report of the Committee on Minimum Standards for Design, Construction and Maintenance of a Public Water Distribution System .... Robert L. McNamee
Experiences With Automatic Chlorine Residual Recording .... George J. Hazey
Statistical Evaluation of Bacterial Quality of Raw Water Supplies .... C. J. Velz
Water Plans—Records and Testing .... Raymond J. Faust
Water Fluoridation .... C. V. Tossy

Minnesota Section—September 6–8, 1950

Address of Welcome .... *Mayor* Ed K. Delaney
Response .... Arthur F. Mellen
Problems in Water Supply During Floods .... William D. Hurst and R. M. Jenson
Three Years' Results of the Numerical Rating System on Minnesota Water Supplies ....
O. E. Brownell
Submersibile Pumps .... *A Motion Picture*
Proposed Water Works Improvement at Minot .... Charles R. Podas
Symposium on Corrosion:
Causes and Control .... W. C. Thompson
Stabilization of Water .... William Yegen
A Summary of Chlorination Principles and Practices .... Harry A. Faber
Well Construction .... *A Motion Picture*
Panel Discussion—Well Problems .... *Led by* C. F. Wimer
Panel Discussion—Distribution System Problems .... *Led by* George J. Troman
Are Your Public Relations Showing? .... E. L. Filby
What Makes a Water Works Work? .... Leonard N. Thompson

Missouri Section—October 1–3, 1950

The Social Security Law and How It Affects Municipal and Public Utility Employees ....
Tom L. Gaukel
Diesel Engines in Water and Sewage Plants .... Gilbert Weidlich
Water and Sewage Plants in St. Louis Area:
St. Louis County Water Co. ....
City of St. Louis .... John B. Dean
Kirkwood, Mo. .... Robert Lamberton
Sewage Plants .... George D. Russell

This Is How We Do It (Presentations on Miscellaneous Operating Procedures):
St. Joseph .... Frank J. McAndrew
Boonville .... Claude Fisher
Trenton .... Richard Brown
Joplin .... C. E. Shanze
St. Louis Water Div. .... H. W. Pershall
St. Louis County Water Co. .... Jack Nonmensen
Fayette .... Morris Thurman
Revitalizing of Water Mains to Minimize Rust and Odors and Tastes .... W. T. Schrenk
Cleaning Water Mains .... *A Motion Picture*
Meter Maintenance .... Fred Husman
Operation and Maintenance of Deep Well Turbine Pumps .... E. L. Kuefler
Long-Line Chlorinating System at St. Louis Water Filtration Plants .... E. E. Easterday

Montana Section—April 21–22, 1950

Address of Welcome .... *Mayor* Ralph Starr
Response .... Joseph M. Schmidt
Round Table Discussion—Local Operating Problems and Procedures .. *Led by* E. Henderson
Electronic Pipe Locating .... W. Blankmeyer
Aspects of Water Pollution Control as It Affects Public Water Supplies .... L. F. Warrick
Good Lawn Management .... L. A. MacDonald
Problems in Canadian Water Works Administration .... A. E. Berry
Montana Rate and Service Regulations of Water Utilities .... E. S. Booth

Nebraska Section—April 13–14, 1950

Address of Welcome .... *Mayor* Clarence Miles
Stream Pollution:
National Aspect .... L. E. Ordelheide
Nebraska Aspect ....
Two-Way Radio Use in a Municipal Electric and Water Utility .... C. J. Hutchinson
Realistic Public Relations .... Lee M. Nelson
Water Meter Department Practices .... W. H. Dominick
Personnel and Public Relations in Municipal Government .... Winfield Best
Financing Municipal Extensions and Improvements Under Existing Nebraska Laws .... E. H. Curtiss

New Jersey Section—October 26–28, 1950

Tokyo Water Works .... *A Motion Picture*
What Happened in One City When It Ran Completely Out of Water ..... L. E. Wickersham
Discussion .... Frank Knapp
Panel Discussion—Water Conservation Measures in the Recent Water Shortage .... *Led by* James E. Garratt, A. F. Eschenfelder, W. H. Boquist, John J. Reager and Ralph L. Tyler
Water Supply in London .... *A Motion Picture*
The Role of Water Works in Civilian Defense .... Alfred H. Fletcher
Forum—Water Works From a Commissioner's Viewpoint .... *Led by* Frank Livermore, Leo P. Carlin, Lewis J. Messano, Frank B. Gail and W. Parsons Todd
Trenton Cleans Its Water Mains .... *A Motion Picture*
New Jersey Water Works .... Robert S. Shaw
Forum—Headaches and Problems of the Water Works Man .... *Led by* J. A. Carr, William G. Banks, Harold M. Ohland, Walter Spencer and Nelson S. Butera
Round Table Discussion .... *Led by* William Monie
Experience With "Reflective Type," Fluorescent, Luminous and "Scotch-Lite" Paints on Hydrants
Rubber Joint Pipe Rings
Meter Repair Costs
New Methods, New Equipment, New Operations and New Gadgets in Water Works
Fluoridation Experiences

New York Section—March 30–31, 1950

Regional Plan for Water Supply for Northwestern New York State.........Charles H. Sells
Proposed System of Classes and Standards Applicable to Waters of New York State.......
Anselmo F. Dappert
Current Appraisal of the Fluoridation of Public Water Supplies.............Charles R. Cox
Sterilization With Chlorine Dioxide at Niagara Falls....Fred V. H. Piper and J. C. Burnett
Water—Special Delivery..*A Motion Picture*
Round Table Conference..*Led by* S. P. Carman
Organization of Local Water Works Associations
What Can We Do to Increase Membership and Benefits of Membership?
Upflow Flocculators
Diesel Engines
Labor Problems
Legislation
Water Works Schools

New York Section—September 7–8, 1950

Random Thoughts on Financing, Returns and Rate Problems.........Richard L. Rosenthal
Problems in Cold-Weather Operation of Water Works....................E. J. Van Deusen
Civil Defense for Water Works...Earl Devendorf
Waverly Water Department...*A Motion Picture*
Round Table Conference..*Led by* S. P. Carman
Atomic Pollution of Water Supplies
Ground Water Problems
Water Rates and Rate Making
Compensation of Water Works Personnel
Diatomite Filters
Prime Movers for Pumps

North Carolina Section—November 13–15, 1950

Durham's Water Works..D. M. Williams
The Present Crisis in Municipal Finance..............................George Franklin
Water Works Discussion Panel..................................*Led by* W. E. Long
Regulations Governing Water Service..............................Joe L. Greenlee
Water Plant Records...John Andrews
Use of Radio by Water Departments..............................George S. Moore
Water Waste Surveys and Unaccounted-for Water.......................E. M. Johnson
Need of Civil Defense in the Present Emergency..........................E. Z. Jones
When Should Equipment Be Replaced?...............................W. Victor Weir
Discussion of Current Developments in Stream Sanitation Program...........J. M. Jarrett
Public Relations...M. T. Dunlap
Sewage Works Discussion Panel..........................*Led by* Emil T. Chanlett
Rendering Plant Waste Studies.....................................Marvin Granstrom
Selection of Sewage Treatment Processes............................Ralph E. Fuhrman
Industrial Waste Studies...John C. Grey

Ohio Section—September 28–29, 1950

Semiautomatic Treatment Plants—Design and Construction...............Raymond Fuller
Discussion.........................G. E. Babcock, R. H. Finn and Paul McCampbell
Automotive Equipment, Operational Control, Maintenance and Emergency Use............
J. J. Antweiler
Mechanical Equipment—Its Use in Distribution, Construction, Operation and Maintenance Work...S. C. Simmermacher
The Ohio Public Employees Retirement System.........................Fred L. Schneider
Panel Discussion—Water Works Wages..............................*Led by* W. R. LaDue
Report on A.W.W.A. Activities...W. R. LaDue
Adequacy of Wages in the Water Works Profession.....................C. S. Finkbeiner
Operators' Wages..L. T. Fawcett

Employees' Training Program.......T. O. Jenney
Visual Training Aids—Films Used in Training Ohio Bell Telephone Company's Employees..
Chlorination.......E. B. Evans
Chlorine Dioxide.......D. T. Duke
Activated Carbon.......W. I. Van Arnum
Reservoir Control.......Clarence E. Taft
Collection of Samples From the Distribution System.......T. R. Lathrop
Automatic Control of Water Pumpage and Storage.......John Houston
The Use and Operation of Leak Locaters and Pipe Finders.......D. L. Blaik
Meter Repairing, Servicing and Sizing.......H. W. Niemeyer
Civil Defense in Ohio.......W. R. LaDue

Pacific Northwest Section—May 11–13, 1950

Water Works Operators' Forum.......*Led by* C. R. Harlock
Sewage Works Operators' Forum.......*Led by* Donald J. Seidel
State Highway Department and Public Utility Relationship on Construction Projects.......
Deene Seeger
Public Relations.......Walter J. DeLong
Points of Interest in Tacoma's Water System.......W. A. Kunigk
Importance of Water Works Records.......Fred Jones
Panel Discussion—Loss of Water Revenue—Waste of Water and Metering Demands.......
E. Jerry Allen, Arthur Musgrave, Ray Vinson and R. C. Smolinski
Population Forecasting.......Calvin F. Schmid
Effect of Yarning and Packing Material on Pipe Disinfection.......
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Fluoridation of Water Supplies. Robert A. Downs
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Ecology of Organisms of Significance in Surface Water Supplies. C. M. Palmer and C. M. Tarzwell
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Fluoridation of Public Water Supplies. Franz J. Maier
Construction Cost Reductions Through Improved Plans, Specifications and Contract Documents. R. M. Dixon

Relative Resistance of Coliform and Enteric Pathogens in the Disinfection of Water Wells With Chlorine....Paul Kabler
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Proposed Fox River Valley Pipeline From Lake Michigan....Bruno Hartman
Pretreatment Basin for Algae Removal....Andrew J. Marx
Panel Discussion....*Led by* Norton A. Thomas, William U. Gallaher, James E. Kerslake, O. J. Muegge and M. Starr Nichols
Deep Well Turbine Pump Efficiencies....A. O. Fabrin
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Bazooka Shooting of Wells....G. L. Smith
Does Your Water Works Work for Nothing?....C. MacDonald
Discussion....Harold T. Rudgal, Arthur P. Kuranz and Harold L. Londo
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Section	1946	1947	1948	1949	1950	Meeting Place—1950
Alabama-Mississippi	——	May 23–24	Oct. 13–15	Oct. 19–21	Oct. 11–13	Mobile, Ala.
Arizona	——	Oct. 9–11	Apr. 2–4	Apr. 1–3	Mar. 31–Apr. 2	Safford, Ariz.
	——	——	Oct. 15–17	Nov. 11–13	Nov. 30–Dec. 2	Tucson, Ariz.
California	Oct. 22–25	——	Oct. 27–29	Apr. 29*	Apr. 21*	Santa Cruz, Calif.
	——	——	——	Oct. 25–28	Oct. 24–27	San Diego, Calif.
Canadian	Apr. 8–10	Apr. 14–16	Apr. 12–14	Apr. 25–27	Apr. 3–5	Niagara Falls, Ont.
Chesapeake	——	——	——	Nov. 2–4	Nov. 1–3	Wilmington, Del.
Cuban	Nov. 22–24	Nov. 20–22	Dec. 2–4	Dec. 1–3	Nov. 13–15	Ft. Lauderdale, Fla.
Florida	Nov. 22–24	Nov. 20–22	Nov. 18–20	Nov. 14–16	Nov. 13–15	Ft. Lauderdale, Fla.
Four States	Sept. 26–28	Nov. 19–21	Oct. 20–22	——	——	
Illinois	——	Apr. 17–18	Apr. 15–16	——	Apr. 12–14	Chicago, Ill.
Indiana	Apr. 2–3	May 7–9	Apr. 21–23	Apr. 20–22	Apr. 26–28	West Lafayette, Ind.
Iowa	Nov. 4–5	Oct. 9–11	Oct. 5–6	Oct. 6–7	Oct. 26–27	Des Moines, Iowa
Kansas	Mar. 7–8	Mar. 13–14	Mar. 11–12	Apr. 21–22	Apr. 19–21	Salina, Kan.
Kentucky-Tennessee	Oct. 28–30	Sept. 22–24	Aug. 23–25	Oct. 31–Nov. 2	Oct. 23–25	Memphis, Tenn.
Michigan	Sept. 18–20	Sept. 18–20	Sept. 22–24	Sept. 28–30	Oct. 25–27	Detroit, Mich.
Minnesota	Mar. 14–15	Mar. 13–14	Sept. 1–2	Sept. 8–9	Sept. 6–8	St. Paul, Minn.
Missouri	Oct. 21–22	Oct. 27–28	Oct. 24–26	Sept. 25–27	Oct. 1–3	St. Louis, Mo.
Montana	Apr. 12–13	Apr. 25–26	Apr. 9–10	Apr. 8–9	Apr. 21–22	Missoula, Mont.
Nebraska	——	Apr. 11–12	Apr. 22–23	Apr. 21–22	Apr. 13–14	Lincoln, Neb.
New England	Oct. 17	——	——	——	——	
New Jersey	Mar. 1	Feb. 19	——	Feb. 17	Feb. 15	Newark, N.J.
	——	June 19	——	June 23	——	
	Nov. 7–9	Nov. 6–8	Nov. 4–7	Nov. 17–19	Oct. 26–28	Atlantic City, N.J.
New York	Mar. 28–29	Apr. 10–11	Apr. 1–2	Jan. 21	Jan. 17	New York, N.Y.
	Oct. 3–4	Sept. 4–5	Sept. 14–17	Apr. 28–29	Mar. 30–31	Rochester, N.Y.
	——	——	——	Sept. 6–7	Sept. 7–8	Upper Saranac Lake, N.Y.
North Carolina	Nov. 18–20	Nov. 10–12	Nov. 8–10	Nov. 7–9	Nov. 13–15	Durham, N.C.
Ohio	Oct. 10–12	Sept. 30–Oct. 2	Oct. 7–8	Nov. 3–4	Sept. 28–29	Columbus, Ohio
Pacific Northwest	May 23–25	May 15–17	May 13–15	May 12–14	May 11–13	Tacoma, Wash.
Pennsylvania	——	——	——	Sept. 14–16	Oct. 18–20	Pittsburgh, Pa.
Rocky Mountain	Sept. 12–13	Sept. 25–26	Sept. 15–17	Sept. 21–23	Sept. 27–29	Santa Fe, N.M.
Southeastern	Sept. 9–11	Nov. 3–5	Dec. 6–8	Dec. 5–7	Oct. 23–25	Charleston, S.C.
Southwest	Oct. 14–17	Oct. 12–15	Oct. 11–13	Oct. 10–12	Oct. 16–18	New Orleans, La.
Virginia	Nov. 14–15	Nov. 17–18	Oct. 25–26	Oct. 24–25	Nov. 6–7	Richmond, Va.
West Virginia	Oct. 17–18	Oct. 2–3	Sept. 30–Oct. 1	Sept. 22–23	Sept. 13–14	Huntington, W.Va.
Western Pennsylvania	Sept. 12–13	June 12–13	Oct. 20–22	——	——	
Wisconsin	Nov. 15–17	Oct. 23–25	Oct. 28–29	Oct. 11–13	Sept. 19–21	Oshkosh, Wis.

* Regional meetings.

Section Membership at Time cf, and Total Attendance at, Section Meetings—1946–1950

SECTION	1946		1947		1948		1949		1950	
	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance
Alabama-Mississippi	*	*	52	87	137	116	164	140	167	141
Arizona‖	*	*	26	134	41	159	69	181	83	93
California‖	684	857	726	§	770	1,133	826	831	947	1,267
Canadian	383	600	404	730	459	732	485	574	515	728
Chesapeake	*	*	*	*	*	*	209	196	245	149
Cuban	36	26	36	116	36	75	57	71	61	216††
Florida	149	142	165	116	190	103	216	174	240	216††
Four States	343	172	350	180	343	191**	#	#	#	#
Illinois	353	‡	362	318	402	321	450	‡	459	284
Indiana	203	226	206	224	201	242	207	266	256	264
Iowa	67	106	93	115	95	157	102	138	109	242
Kansas	55	107	93	132	110	118	113	168	139	179
Kentucky-Tennessee	131	98	132	133	138	206	196	153	199	222
Michigan	181	230	199	222	232	248	254	211	284	214
Minnesota	120	179	161	206	172	322	182	169	208	177
Missouri	154	†	150	88	154	76	157	62	169	74
Montana	59	78	61	69	63	108	61	94	58	140
Nebraska	*	*	35	†	41	†	54	18	55	23
New England	170	57	172	‡	172	‡	187	‡	192	‡
New Jersey‖	305	250	309	217	320	208	339	218	350	218
New York‖	575	126	627	230	644	200	643	250	682	†
North Carolina	162	237	169	212	174	238	171	226	176	222
Ohio	332	†	336	251	364	258	380	308	382	321
Pacific Northwest	267	234	267	234	264	260	277	267	295	330
Pennsylvania	*	*	*	*	*	*	345	147	390	182
Rocky Mountain	103	84	117	92	135	74	147	86	145	126
Southeastern	238	179	151	136	149	154	152	161	170	152
Southwest	434	430	557	428	558	545	659	618	678	795
Virginia	125	219	146	201	154	224	167	228	171	215
West Virginia	80	131	82	120	88	172	87	123	92	154
Western Pennsylvania	159	115	157	132	159	191**	#	#	#	#
Wisconsin	133	272	138	302	146	239	143	301	150	290

* Section not then organized.
† No record of attendance.
‡ No regular meeting scheduled. Membership given as of dates of conferences.
§ Regular meeting cancelled. Business meeting held at annual conference.
‖ Only one of Section's meetings recorded here.
Section discontinued.
** Joint meeting, to form Chesapeake and Pennsylvania Sections.
†† Joint meeting.

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Journal

AMERICAN WATER WORKS ASSOCIATION

VOLUME 42 • 1950

AMERICAN WATER WORKS ASSOCIATION
Incorporated
500 Fifth Ave., New York 18, N. Y.

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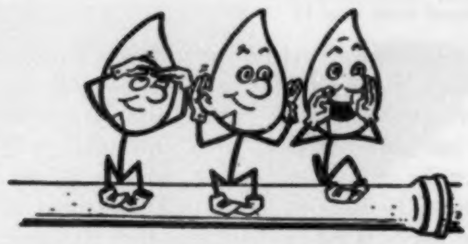

Percolation and Runoff

Editors Anonymous—supersecret society of P&R contributors—is celebrating another anniversary. And though the celebration, as indeed their own membership, may be so secret that even EA members themselves know nothing about it, it may be well if we wish them openly our every wish for a particularly Merry Christmas, an especially Happy New Year and a permanently Incurable Addiction.*

Strictly titillatorian in set-up, Editors Anonymous has come to designate its members on a direct contributory scale, based now on two simple grades: *Deetees*—those who have made innumerable contributions of usable material to P&R; *Shakes*—those who have made numerable contributions. By constitutional amendment, a new grade—*Jitters*—to include those who have had only one or two attacks of contributionitis, will be introduced in 1951.

Membership dues are one contribution a year, conscious or otherwise, but grades above *Jitters* must, of course, be earned each year.

For 1950, then, the *Deetees* (again) were three charter members: P. S. Wilson, E. L. Filby and Joe Wafer.

Shakes for a second time were: A. P. Black, M. G. Mansfield and E. A. Sigworth.

And new *Shakes* included: Edward Bartow, Boyd Bennett, John M. Diven, William Macpherson, George J. Natt, T. M. Riddick, D. Birney Stokes, Ralph Tyler, W. Victor Weir, A. E. Williamson and R. C. Willson.

To these seventeen, we owe much more than the name-calling indulged in here, but they understand, we're sure, that we must make the society as attractive as possible to induce more membership in 1951. Meanwhile, who can blame us for looking forward to a full menagerie of Deetees?

Authority is what A.W.W.A. has in profusion—good classic authority, too, though naturally enough disguised to qualify for membership in an illiterary organization. Thus, William Shakespeare came in as man-

* Life membership.

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ager of the Nova Scotia Board of Insurance Underwriters, Robert Browning as a cathodic protectionist with Wallace & Tiernan, Samuel Johnson as a chemical engineer with Dearborn Chemical Co. and no less than three Walter Scott's, no one of whom has owned up to a "Sir." But that's only the beginning: there are Robert L. Stevenson, mayor, no less, of the town of Columbus, Ind.; Eugene O'Neill, Asst. Supt. of Distribution at San Diego, Calif.; Thomas Wolfe, engineer for the Cast Iron Pipe Research Assn.; and an exlibrettist named Richard Wagner doing duty with the Army in Munich, Germany. Disguised right down to bare initials come C. Aiken, Clearwater, Fla.; W. E. Blake, Cleveland, Ohio; T. A. Caldwell, San Antonio, Tex.; W. Collins, Dallas, Tex.; J. Hilton, Bellingham, Wash.; F. S. Key, Kingsport, Tenn.; A. J. Noyes, Deming, N.M.; and G. Stein of Mt. Vernon, N.Y.

In addition to these distinguished names, we have, of course, a number like George Marshall (Portland, Ore.) known principally for not having written a book and James John Poet (San Bernardino, Calif.) whose name suggests that he has. And then, quite beside the point, there is L. F. Beers of Rochester, N.Y., who advertises "When You Want WATER Call for Beers." Which sounds like a good idea right now.

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Water's powers, about which we used to carry on at great length, haven't been forgotten in the interim; it's just that we felt silence the better part of reporting during the past session of Congress. Now, however, that the tale of tritium has become common knowledge, we can at last 'fess up to the fact that we not only knew it, but suspected it when we were still in knee pants.

In the event that your own knowledge is of the uncommon variety, we might explain that tritium, one of the basic ingredients of the hydrogen (H) bomb, has been discovered in water, there deposited after its production in the upper atmosphere by cosmic rays bombarding the earth from outer space. Of course, there are many other facts about waterborne tritium—written chemically HOT (not to be confused with hot although sometimes *hot*)—in which you may be very interested. Most of them, however, except such publicity blurbs as the note that there are two sextillion atoms of hydrogen to only 2,000 atoms of tritium in a drop of water, are undoubtedly secret. Even having read all about them, we find them still a secret.

What we started to point out, though, was the fact that when, as a child, we devised water bombs from paper sacks and the soft, but obviously heavy, water of New York City, we must have had an inkling of their significance. Certainly when our parents demonstrated that we would find ourselves red (and sore) all over if we continued the pursuit unsecretly, we immediately went underground, conducting all our Bikinis from other people's apartments—preferably those of upstairs friends.

Since it was found impractical to obtain adequate supplies of this rarest of all natural elements from water, water works men needn't worry about competition for their sources of supply. But since it costs approximately half a billion dollars to produce one pound of the product in atomic reactors, its presence in water should certainly merit that rate increase if other arguments are unsuccessful.

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The Man of Kansas City is what they're calling Tom Veatch these days, referring, of course, to his honorable mention in Jonathan Daniels best-selling *The Man of Independence*. And despite the fact that it is his praises as a roadbuilder that are there sung, we, who elected him *our* president, can still call him our own. After all, who now thinks of that other president as a haberdasher except a few envious competitors who adopted an elephant as a symbol.

All water works aside, though, the roads of Jackson County, Mo., are said to be a credit to both Tom and Harry.

The Man of Westchester County, meanwhile, is one Richard M. McLaughlin, who is Director of the Division of Sanitation of the county health department when he isn't busy with his duties as Secretary-Treasurer of the Westchester Water Works Conference. "Mr. Mac" became "The Man" one night last October when a couple hundred members and friends of the Conference tendered him a testimonial dinner. And what made him "The Man" as far as we're concerned is the fact that the testimonial came without benefit of Mac's death, resignation or even retirement. As a matter of fact, he and the triple-W-C, are continuing hand in hand to make that local chapter of the water works fraternity an outstanding one.

Pappy Papp and his son Remy became the heroes of a front-page "fairy" tale in the Newark *Star-Ledger* last September 27 and then were featured again in the pages of the New York *Times* on October 1. So you should be aware that Pappy is new A.W.W.A. member Remig A. Papp—now on the staff of Malcolm Pirnie Engineers—and that son Remy is new Princeton sophomore Remig A. Papp (Jr.)—now on a scholarship. And both of them achieved their present high status via janitorship.

The tale actually began in 1945, when Mr. Papp, a civil engineer, his wife, son and daughter fled Hungary before the Russian army. Ending up in Western Germany, where the elder Papp worked for the British authorities and the younger went to school, the Papps were classified as D.P.'s. Thus, last year, they made their entry into the United States and, to make ends meet, father and son took jobs as janitors at Princeton University. Now the elder Papp is working at his old forte and the younger is studying to become an A.W.W.A. member too.

Frederick H. Weed, chief of the Planning Div., Dept. of Water & Sewers, Miami, Fla., has joined the New York consulting firm of Buck, Seifert & Jost as an associate.

Milton Rosen, commissioner of the Dept. of Public Works in St. Paul, Minn., and long-time member of A.W.W.A., has been elected president of the American Public Works Assn.

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The force-account method of laying mains has run into severe opposition—punctuated by violence—in Kansas City, where the mystery dynamiting of Water Dept. construction equipment climaxed a bitter dispute between department director Melvin P. Hatcher, on the one hand, and representatives of the heavy contractors and the heavy construction laborers union on the other. Hatcher's stand, which received editorial support in the K.C. *Times,* is that the department can do small extension jobs most economically with its own crews, and that only large projects should be placed with outside contractors. Both contractors and union representatives (neither of whom are exactly idle these days) object to this policy, because it deprives them of a plum they apparently think they are entitled to—for what reason it is difficult to determine. The sabotage, which damaged $5,000 worth of machinery but fortunately caused no injuries, has occasioned the posting of a like sum by the city council as reward for information leading to the arrest and conviction of the culprits. A $2,000 reward has also been posted by the contractors, presumably as a public disavowal of the use of violence. Officers of the Kansas Bureau of Investigation, who have joined local police and fire prevention officials in investigating the case, have said that the dynamiting appeared to be similar to blasts which occurred in Wichita and Topeka.

The importance of water works defense activities was well illustrated last October in civil war-plagued Indo-China. There it was that communist-led Viet Minh guerrillas demolished some 250 ft. of transmission pipe in the mountains north of Haiphong to cut off that city, second largest port in the country, from its regular source of fresh water. The extent of the crisis during the 10 to 12 days required for repairs can be measured by the fact that only five days' supply for even domestic needs was available. That left the city's industry crippled, it kept several ships tied up in port after sailing was scheduled, and it kept the French army busy trucking supplies from 15 miles away to keep hospitals and army installations going. You shouldn't need a palmist to point out that as a lifeline.

(*Continued on page 12*)

"City highly endorses Badger Meters and Testing Machines"

That's what the mayor of one Illinois city wrote to another, adding: "Operation of these meters has always been satisfactory and maintenance-cost very reasonable . . . in our meter shop, a Badger Testing Machine enables us to see the quality of our work, which was not possible before we bought the Testing Unit".

In over 5000 communities, waterworks men know that "It pays to BUY BADGER".

ANOTHER NEW Badger Chart, No. 696 (Practical floor plan for a large meter repair shop). Available without cost or obligation. WRITE today for this chart.

BADGER METER MFG. CO.
Milwaukee 10, Wisconsin

BRANCH OFFICES:
New York City • Philadelphia • Worcester, Mass. • Savannah, Ga. • Cincinnati • Chicago Kansas City, Mo. • Waco, Texas Salt Lake City, Utah • Portland, Ore. • Seattle, Wash. • Los Angeles

You will find a Badger Meter size and type for every waterworks service. Shown here are Model SC-IOT (for warm climates), and Model A-IOT (for cold climates) . . . sizes 5/8" to 1¼" . . . other models in sizes up to 12". Write for complete information and prices.

BADGER Water METERS

ACCURACY · LOW-COST MAINTENANCE · DURABILITY · SENSITIVENESS

(*Continued from page 10*)

A substitute for water is going to show up one of these days—mark our word. Just think about such things as atomic energy, radioisotopes, antibiotics, antihistamines, television, plastics—even nylons—all the innovations, improvements, all the tools of progress in civilization. Then think of water and consider how it has disimproved in just the last half century. Of course we've learned how to prevent it from killing people, how to reduce its stench, even how to destroy its taste, but we're a far cry from making it what it used to be—what it used to be, that is, back in the days when even hardness didn't matter because we didn't use soap. As a matter of fact, remembering our present treatment schedules, which include provision for the addition of such substances as copper sulfate, chlorine, ammonia, activated carbon, sulfur dioxide, fluorides and a good many more, we begin to wonder if we don't already have a substitute.

Carlon Products Corp. is now furnishing a plastic pipe with threaded ends, together with molded plastic threaded fittings. Designated Carlon "TL," the pipe is furnished in 20-ft. lengths in diameters from ½ to 2 in. and incorporates standard International Pipe Threads. It can be cut and threaded with conventional tools.

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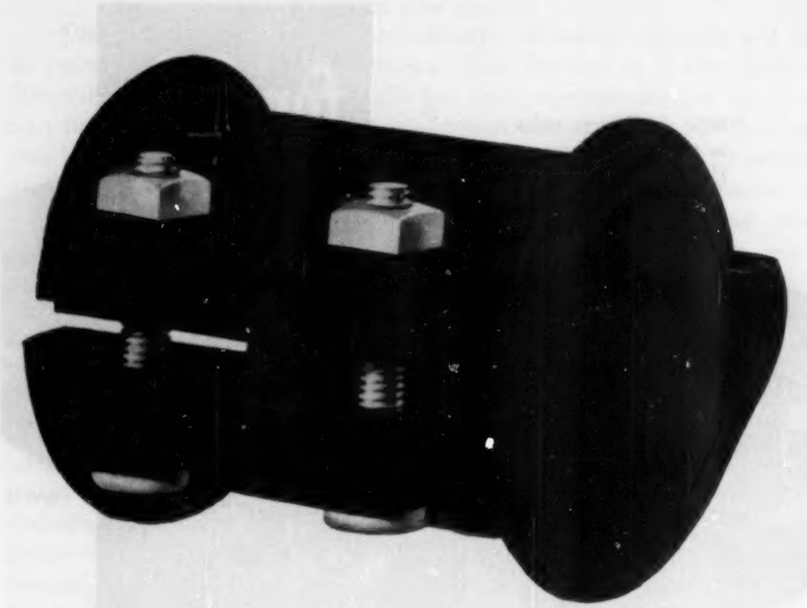
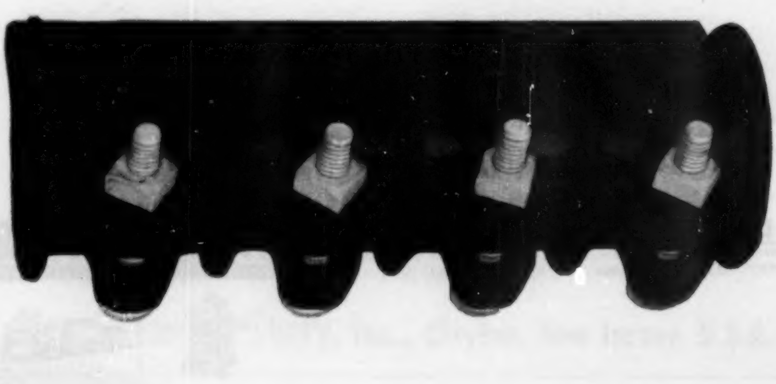
(*Continued from page 12*)

Charles P. Hoover, renowned authority on water treatment and for 42 years associated with the Columbus, Ohio, Division of Water, died on November 14, at the age of 66. He had been superintendent of the division since the death a year ago of his brother Clarence, who had held the post before him, but years of accomplishment had made him better known as the division's chief chemist. A leader in the study and practice of softening, he had conducted many experimental investigations and published reports—many of them in these pages—which earned him an international reputation. Honors had been heaped on him, including the Ohio Section's Fuller Award, Honorary Membership in A.W.W.A., and the naming, by the city of Columbus, of a new dam jointly for himself and his brother.

The Sixth Industrial Waste Conference will be held at Purdue Univ. on February 21–23, 1951. The program will include papers on recent developments in waste control and utilization in various fields, and discussions of new laws and regulations, stream quality and stream surveys. Reservations should be made well in advance at the Union Club on the campus, or at the Fowler, Cedar Crest or Lahr hotels. The registration fee for the conference will be $4.00.

(*Continued on page 18*)





(Continued from page 14)

Distribution system with smile might be the title for the adjoining photograph if we didn't want to point out that the Grecian urn involved would inspire but poor poetry now. At any rate the war rubble in the background should explain the necessity for this current Greek water distribution system and the necessity, too, for Marshall plan assistance—which, in turn, is why A. E. Williamson Jr. is now in Greece acting as consultant to ECA on water and sewerage, and why, furthermore, he was able to get the picture and send it to us.

A little over 5 ft. of head, we would say.

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(Continued from page 18)

The Triple Check Automatic Card Indexing System recently introduced by A.W.W.A. Associate Member Remington Rand Inc., is still another indication that we're growing old. Time was when the more complex we found a thing, the more of a challenge it seemed. Now the thought of filing our cards by letter, number *and* color just leaves us frightened and confused, more than ever determined to stick to the old alphabet.

Not to be completely senile, however, we should explain that the "triple check" system involves new type card-guide tabs—wide ones, centered along the index, called primary tabs, broken down into 40 alphabetic divisions under which *last* name of individuals and *first* word of firm names are first indexed; and narrower ones, extending sideways across the file, called secondary tabs, broken down into 9 alphabetic divisions under which the *first* name of individuals and the *second* word of firm names are next indexed. Now the primary tabs are numbered by 10's and the secondary tabs from 1 through 9 under each 10 unit and the cards, of course, have individual numbers which place them down through the secondary tabs, and these numbers are the second of the triple check—the alphabet being the first. Then as a third check, the secondary tabs are colored as follows: 1–3, tan; 4–6, green; 7–9, yellow. Thus you'd find Charles Adams under A–10, C–2, tan and Zachary Adams under A–10, U–Z–9, yellow. Similarly you would find Colorado Industrial Commission under C–50, G–I–4, green, whereas State of Colorado Income Tax Department would be under St–330, M–O–6, still green.

If you wish to install the system, however, we suggest you get in touch with somebody at the Management Controls Div. of Remington Rand (R–280, P–R–7, yellow) at 315 Fourth Ave., New York 10, or at least ask for folder LBV–520—four color.

David Auld, superintendent and chief engineer of the Washington, D.C., Water Dept., has been appointed deputy director of sanitary engineering for the district.

(Continued on page 22)


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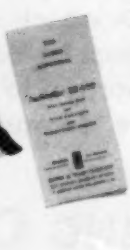

(Continued from page 20)

The one-piece idea in swimming, which has been on its way out ever since some of our unblushing bathing beauties saw what unblushinger French ones were wearing on the Riviera, is now experiencing a comeback. But don't worry—this time it's a swimming pool rather than a swimming suit that is all of a piece.

What we're talking about is a new $100,000 therapeutic unit being installed at the New York University-Bellevue Medical Center in New York City. The pool, which measures 25 ft. in length, 8½ ft. in width and 2 ft. 11 in. to 5 ft. in depth, was delivered as a single piece of welded stainless steel. When ready for use, it will be equipped with special access ramps and an overhead traveling crane for stretcher patients. Furthermore, *this* one-piece item is going to have something to do with water.

A new single-strap pipe clamp which utilizes a special molded rubber gasket to effect a leakproof and oil-resistant seal has been produced by Smith-Blair, Inc. The taper seal principle, which requires only a moderate tightening of strap nuts, depends partly upon the wedging action produced by internal hydraulic pressure upon the gasket, and was originally developed for use on asbestos-cement pipe.

(Continued on page 56)

Professional Services

Membership Changes

NEW MEMBERS

Applications received October 1 to 31, 1950

Amanzimtoti Regional Water Supply Corp., Dennis C. Mullins, Mgr.-Engr., Box 26, Amanzimtoti, Natal (Corp. M. Oct. '50)

Anderson, William A., Jr. Research Engr., Univ. of California, Berkeley 4, Calif. (Jr. M. Oct. '50)

Armstrong, Donald, Pres., U.S. Pipe & Foundry, Drawer 81, Burlington, N.J. (Oct. '50)

Avil, E. May, (Miss), *see* North Miami (Fla.) Water Dept.

Bankson, E. Edwin, Asst. Gen. Mgr., Munic. Authority of the City of New Kensington, 720—4th Ave., New Kensington, Pa. (Oct. '50)

Barter, Herman, *see* Sierra Madre (Calif.)

Becker, Clifford, Chief Operating Engr., Water Works, Hamilton, Ohio (Oct. '50)

Bika, Gabriel, Distr. System Constr. & Maint. Foreman, Water Dept., North Miami, Fla. (Oct. '50)

Black, William J., Civil Engr., J. M. Montgomery & Co., Inc., 900 S. Robertson Blvd., Los Angeles 35, Calif. (Oct. '50)

Boyle, J. R. Lester, Civil Engr., 328 Spurgeon Bldg., Santa Ana, Calif. (Oct. '50)

Bradbury, Alfred M., Sales Engr., James B. Clow & Sons, Birmingham, Ala. (Oct. '50)

(*Continued on page 32*)

(*Continued from page 30*)

Brown, William C., Engr., Water Dept., 111 W. Pennsylvania St., San Diego 3, Calif. (Oct. '50)

Burkholder, J. L., *see* San Diego County (Calif.) Water Authority

Busch, Arthur W., Research Asst., Massachusetts Inst. of Technology, Cambridge 39, Mass. (Jr. M. Jan. '50)

Buschman, Francis Wallace, Prin. Asst. Supt., Meter Operation & Maint., Bureau of Water Supply, Baltimore, Md. (Oct. '50)

Bush, Loren S., Chief Engr., Board of Fire Underwriters of the Pacific, 215 Battery St., San Francisco, Calif (Oct. '50)

Caruthers, Dale Eugene, Sanitarian, Wayne County Health Dept., Eloise, Mich. (Oct. '50)

Clark, Robert, Clark Drilling Co., 2620 College Ave., Indianapolis, Ind. (Oct. '50)

Coastal Chemical Co., Inc., Robert B. Jackson, Sales Director, ACL Warehouse #1, E. Broad & Liberty Sts., Savannah, Ga. (Assoc. M. Oct. '50)

Coates, Joseph, Jr., Mgr., Beach Co., Isle of Palms, S.C. (Oct. '50)

Cole, Wayne B., Waterworks Supt. & Chief of Police, Conway, N.C. (Oct. '50)

Crawley, Owen L., Div. Foreman, Metropolitan Water Dist. of Southern California, Box 126, Brea, Calif. (Oct. '50)

Culver, Town of, Verl McFeely, Water Supt., Culver, Ind. (Corp. M. Oct. '50)

Cunningham, John A., Supt., Sunny Slope Heights Water Co., 6915 Jurupa Rd., Riverside, Calif. (Oct. '50)

Damschroder, Norman E., Supt., Light & Water Plant, Elmore, Ohio (Oct. '50)

Davenport, Royal W., Chief, Tech. Coordination Branch, Water Resources Div., U.S. Geological Survey, General Services Bldg, Washington, D.C. (Oct. '50)

Davis, Ralph Cushman, Plant Supt., Metropolitan Water Dist. of Southern California, Box 38, La Verne, Calif. (Oct. '50)

DeGroot, Frank P., Chemist & Bacteriologist, Northampton Borough Munic. Authority, 1717 Main St., Northampton, Pa. (Oct. '50)

DeLay, Leslie E., Supt., Water Dept., Covina, Calif. (Oct. '50)

Doepken, Robert D., Sales Engr., De-Laval Steam Turbine Co., 124 W. 4th St., Los Angeles 13, Calif. (Oct. '50)

Dragone, Roy, San. Engr., Dorr Co., 1568 Waverly Way, Baltimore 12, Md. (Oct. '50)

Dudley, Nolan Lewis, Jr., Jr. San Engr., State Board of Health, Raleigh, N.C. (Oct. '50)

Dune Acres Water Dept., L. R. Steere, Town Trustee, Chesterton, Ind. (Mun. Sv. Sub. Oct. '50)

Eckenfelder, W. Wesley, Jr., *see* Eckenfelder Associates, Inc.

Eckenfelder Associates, Inc., W. Wesley Eckenfelder, Jr., Pres., 45 N. Broad St., Ridgewood, N.J. (Corp. M. Oct. '50)

Evans, William Howard, Supt., Albany Water Co., Albany, Ind. (Oct. '50)

Feeney, Joseph Leland, Sales Engr., Process Engrs., 6381 Hollywood Blvd., Los Angeles, Calif. (Oct. '50)

Flock, Byron H., Operator, Water Purification Plant, Borough of Allentown, N.J. (Oct. '50)

Flor, Loy Lorenz, San. & Corrosion Engr., La Mesa, Lemon Grove & Spring Valley Irrigation Dist., 4769 Spring St., La Mesa, Calif. (Oct. '50)

Frame, B. G., Gen. Mgr., Ulrich Chemical Co., 31 E. Georgia St., Indianapolis, Ind. (Oct. '50)

Friend, Ardo M., Partner, Ralph L. Woolpert Co., 360 W. 1st St., Dayton 2, Ohio (Oct. '50)

Fulmer, Olen C., Partner & Mgr., Culligan Soft Water Service, 212 Prospect St., Ashland, Ohio (Oct. '50)

Fynsk, Arthur, Student, Massachusetts Inst. of Technology, Cambridge, Mass. (Jr. M. Oct. '50)

Garcia, Raymond F., Boyce Co., Box 3042, Daytona Beach, Fla. (Oct. '50)

Gates, M. E., Asst. Secy., Lake Center Water Cooperative, Route 2, Box 317 D, Tacoma, Wash. (Oct. '50)

Gay, Henry Rives, Asst. Chemist, Clarksburg Water Board, 1099 Van Buren St., Clarksburg, W.Va. (Oct. '50)

Hall, Marlin Knapp, Constr. & Maint. Supervisor, Distr. System. Water Dept., 776 N.E. 125th St., North Miami, Fla. (Oct. '50)

(*Continued on page 34*)

(Continued from page 32)

Hall, Ray Howard, Water Plant Mgr., 124th St. & 8th Ave. N.E., North Miami, Fla. (Oct. '50)

Hallock, Clair Brantley, Asst. Plant Supt., Comrs. of Public Works, 14 George St., Charleston, S.C. (Oct. '50)

Hammer, Ole J., Supt., Glendora Irrigation Co., 224 N. Michigan, Glendora, Calif. (Oct. '50)

Haner, Norman W., Cons. Engr., N. W. Haner & Assocs., 220 S.W. Alder St., Portland 4, Ore. (Oct. '50)

Harrison, Cala G., Mgr. & Operator, Chambers County Water Control & Irrigation Dist. #1, Mont Belvieu, Tex. (Oct. '50)

Haugen, Lawrence T., Chief Engr., U.S. Pipe & Foundry Co., Burlington, N.J. (Oct. '50)

Hayes, Reginald F., Vice-Pres., Hydraulic Development Corp., 50 Church St., New York, N.Y. (Oct. '50)

Hellige, P. A. E., *see* Hellige, Inc.

Hellige, Inc., P. A. E. Hellige, Pres., 3718 Northern Blvd., Long Island City 1, N.Y. (Assoc. M. Oct. '50)

Henderson, William Bartow, Statistician & Records Clerk, Water Dept., 776 N.E. 125th St., North Miami, Fla. (Oct. '50)

Highlands, Town of, V. W. McCall, Town Clerk, Highlands, N.C. (Mun. Sv. Sub. Oct. '50)

Holmgren, Richard Sigfrid, Jr., Jr. Engr., La Mesa, Lemon Grove & Spring Valley Irrigation Dist., 4769 Spring St., La Mesa, Calif. (Jr. M. Oct. '50)

Holt, Howard Glenn, Foreman of Meter Installation & Repair, Water Dept., 776 N.E. 125th St., North Miami, Fla. (Oct. '50)

Huntington, Ben, Engr., Water Dept., 2244 Famosa Blvd., San Diego 7, Calif. (Oct. '50)

Huso, Phil, Water & Sewage Supt., Finley, N.D. (Oct. '50)

Irvine, Alex, Waterworks Supervisor, Inter-Urban Area Board, Burlington, Ont. (Oct. '50)

Jackson, Robert B., *see* Coastal Chemical Co., Inc.

Jette, A. Norman, Chemist, Culligan Zeolite Co., San Bernardino, Calif. (Oct. '50)

Johnson, Charles Francis, Personnel Director, Southern California Water Co., 1206 S. Maple Ave., Los Angeles 15, Calif. (Oct. '50)

Johnson, Charles Ross, Asst. Mgr., Water Dept., Box 659, Longview, Wash. (Oct. '50)

Jones, James Ronald, Research Asst., Massachusetts Inst. of Technology, Cambridge, Mass. (Jr. M. Jan. '50)

Jones, Reg. C., Box 306, Palm Springs, Calif. (Oct. '50)

Kauffman, Robert C., Engr., Wiedeman & Singleton Engrs., Inc., Box 1878, Atlanta 1, Ga. (Oct '50)

Keller, D. E., Mgr., Water Dept., 38 S. Church St., Hazleton, Pa. (Oct. '50)

Keysor, John W., Engr., Eng. Div., Water Dept., 903 Civic Center, San Diego, Calif. (Oct. '50)

Killeen, Robert F., Sales Engr., Wm. A. Da Lee Inc., 9190 Roselawn, Detroit 4, Mich. (Oct. '50)

Kinston Public Utilities Dept., W. G. McAdams, Supt., 106 W. King St., Kinston, N.C. (Corp. M. Oct. '50)

Kurowski, Peter T., Mgr., Water Dept., Pulaski, Wis. (Oct. '50)

Lau, Curtis W., Sales Engr., S. Morgan Smith Co., York, Pa. (Oct. '50)

Lautz, Harold L., Dist. San. Engr., State Board of Health, Madison, Wis. (Oct. '50)

Lehrmann, E. F., Secy.-Treas., St. Bernard Water Dist. #1, Chalmette, La. (Oct. '50)

Lemieux, Pierre, Water Purification Chemist, 51 Rue des Peupliers, Drummondville, Que. (Oct. '50)

Leslie, James J., Supt., Water Works, Paulding, Ohio (Oct. '50)

Lester, Lindsay, Supt., Water & Sewerage Works, Boaz, Ala. (Oct. '50)

Martin, Lawrence E., Office Mgr., Missouri Water Co., 123 W. Kansas, Independence, Mo. (Oct. '50)

Martinez, J. E., Instructor, Civil Eng. Dept., Univ. of New Mexico, Albuquerque, N.M. (Oct. '50)

Mathews, M. A., Salesman, Neptune Meter Co., 254 Dillon, Houston 17, Tex. (Oct. '50)

McAdams, W. G., *see* Kinston (N.C.) Public Utilities Dept.

(Continued on page 36)

(*Continued from page 34*)

McCall, V. W., *see* Highlands (N.C.)

McDonald, Clyde A., Supt., Meter Div., Water Dept., City Hall, Elgin, Ill. (Oct. '50)

McFeely, Verl, *see* Culver (Ind.)

McGlothlen, Barton F., Pres., Pioneer Gardens Water Co., Inc., 1496 Del Rosa Ave., San Bernardino, Calif. (Oct. '50)

McNeel, Marshall, Jr., Water & Sewerage Comr., Water Works, 25 Ave. H, Galveston, Tex. (Oct. '50)

Monie, William D., Asst. Mgr., Commonwealth Water Co., Summit, N.J. (Oct. '50)

Mugnier, E. A., *see* St. Bernard Water Dist. No. 1.

Mullins, Dennis C., *see* Amanzimtoti (Natal) Regional Water Supply Corp.

North Miami Water Dept., (Miss) E. May Avil, Town Clerk-Treas., 776 N.E. 125th St., North Miami, Fla. (Corp. M. Oct. '50)

Pickard, Ralph C., Director, Environmental San., Evansville-Vanderburgh County Dept. of Health, 201 S.E. 3rd St., Evansville, Ind. (Oct. '50)

Powers, Jerome, Div. Mgr., American Water Works Service Co., 14½ N. 10th St., Richmond, Ind. (Oct. '50)

Remy, Robert E., Water Softening & Filtration Plant Electrical Foreman, Metropolitan Water Dist. of Southern California, 306 W. 3rd St., Los Angeles, Calif. (Oct. '50)

Reynolds, Harold H., Dist. Mgr., DeLaval Steam Turbine Co., 124 W. 4th St., Los Angeles 13, Calif. (Oct. '50)

Richards, Clifford, Owner, Swift Electric Co., Finley, N.D. (Oct. '50)

Ross, W. A., Supt., Water Dept., Ontario, Calif. (Oct. '50)

St. Bernard Water Dist. No. 1, E. A. Mugnier, Pres., Chalmette, La. (Corp. M. Oct. '50)

Sanders, C. A., Instructor, Texas A & M College, College Station, Tex. (Oct. '50)

San Diego County Water Authority, J. L. Burkholder, Gen. Mgr. & Chief Engr., 314–321 Land Title Bldg., San Diego 1, Calif. (Corp. M. Oct. '50)

Schneider, Robert, Geologist in Charge, U.S. Geological Survey, 1428 New Post Office Bldg., St. Paul, Minn. (Oct. '50)

Seppa, Karl E., Div. Sales Engr., Armco Drainage & Metal Products, Inc., Route 1, Danville, Calif. (Oct. '50)

Short, Donald R., Director of Public Works, El Segundo, Calif. (Oct. '50)

Sierra Madre, City of, Herman Barter, Chairman, Water Com., Sierra Madre, Calif. (Corp. M. Oct. '50)

Skelton, John E., Vice-Pres., San Gabriel Valley Water Co., 11142 E. Garvey Ave., El Monte, Calif. (Oct. '50)

Smith, Howard, Field Installations Foreman, North Miami, Fla. (Oct. '50)

Spies, Wilbert E., Dist. Engr., State Dept. of Health, 310 Ludlow Bldg., Dayton 2, Ohio (Oct. '50)

Steele, E. Dwight, Water Supt., Board of Public Affairs, Seville, Ohio (Oct. '50)

Steere, L. R., *see* Dune Acres Water Dept.

Stotts, Donald J., Rubio Canon Land & Water Assn., 583 Sacramento, Altadena, Calif. (Oct. '50)

Stow, James P., Jr., Chief Engr., Munic. Authority of the City of New Kensington, New Kensington, Pa. (Oct. '50)

Swan, Walter S., Box 1010, City Hall, Ventura, Calif. (Oct. '50)

Swanson, Ingolf C., Lab. Technician, Water Dept., 117 E. Hill St., Long Beach, Calif. (Oct. '50)

Taneyhill, Alexander Briscoe, Chem. Service Engr., Electric Chemical Co., 719 Dunkirk Rd., Baltimore 12, Md. (Oct. '50)

Tellett, David P., Sales Repr., Allis Chalmers Mfg. Co., 807 Foshay Tower, Minneapolis, Minn. (Oct. '50)

Therrell, Perry Brock, Asst. Supt., Water Works, Greenville, S.C. (Oct. '50)

Thompson, Perry, Surveyor, Box 1445, Longview, Tex. (Oct. '50)

Thomson, James H., Supt. of Distr., Comrs. of Public Works, Box 829, Charleston, S. C. (Oct. '50)

Thornton, Lester, Supt., Water Works, Bloomington, Ind. (Oct. '50)

Timmerman, A. T., Repr., Automatic Control Co., 757 N. Broadway, Milwaukee 2, Wis. (Oct. '50)

Totman, W. A., Asst. City Mgr., 552 E. "E" St., Ontario, Calif. (Oct. '50)

Vance, Clarence G., Div. Mgr., Elec., Water & Sewer Div., Edison Sault Electric Co., Mackinac Island, Mich. (Oct. '50)

(*Continued on page 38*)

(*Continued from page 36*)

Vandiver, A. D., Salesman, Tennessee Pump & Supply Co., Jackson, Tenn. (Oct. '50)

Wade, Elmo Carlton, Machine Operator, Water Dept., North Miami, Fla. (Oct. '50)

Walker, Samuel A., Jr., Sam Walker & Assocs., 124 S. Woodward, Birmingham, Mich. (Oct. '50)

Ward, James W., Student, Massachusetts Inst. of Technology, 105 Langdon Ave., Watertown 72, Mass. (Oct. '50)

Welch, L. M., Supt., Gulf States Utilities Co., Box 892, Lake Charles, La. (Oct. '50)

Whiteman, Harold J., Supt. of Public Service, 1502 Ruddiman Ave., North Muskegon, Mich. (Oct. '50)

Wilkerson, Kenneth L., Constr. Supt., San Gabriel Valley Water Co., 11142 E. Garvey Ave., El Monte, Calif. (Oct. '50)

Willets, David B., Sr. Hydr. Engr., Div. of Water Resources, 803 California State Bldg., Los Angeles, Calif. (Oct. '50)

Wise, Lauress Lee, Assoc. Editor, *Engineering News-Record*, 68 Post St., San Francisco 4, Calif. (Oct. '50)

Wragg, Thomas S., Mgr., Delaware River Water Co., Beverly, N.J. (Oct. '50)

Zaner, Eugene W., Operator, Water Plant, North Miami, Fla. (Oct. '50)

REINSTATEMENTS

Cox, I. D., Supervisor, Water & Waste Treatment Plant, Ford Motor Co., Monroe Mich. (Jan. '42)

Porter, John Lewis, Chief Design Engr., Fromherz Engr., 823½ Paydras St., New Orleans 12, La. (May '25)

Schneider, Reynolds, Supt., Water Dept., Mackinaw City, Mich. (July '46) *MP*

LOSSES

Resignations

Nason, Edward M., Town Engr., Bridgwater, N.S.

Deaths

Burns, Thomas M., Asst. Mgr. of Sales & Eng., American Locomotive Co., 30 Church St., New York 8, N.Y. (Apr. '35) *M*

Kulin, Harvey J., Secy.-Treas., Couch & Kulin, Inc., 312 E. Washington St., Indianapolis 4, Ind. (Oct. '39) *P*

Matthews, Richard G., Supt., Dept. of Public Service, City Hall, Muskegon Heights, Mich. (Jan. '43) *MP*

Rich, Edward D., 1013 W. Ionia St., Lansing, Mich. (Jan. '39) *Fuller Award '43. P*

Tomek, Arthur O., San. Engr., Washington Suburban San. Com., 4017 Hamilton St., Hyattsville, Md. (Oct. '35) *MPR*

CHANGES IN ADDRESS

Changes received between October 5 and November 5, 1950

Activated Alum Sales Corp., M. E. Shoemaker, Secy., 316 Wyndhurst Ave., Baltimore 10, Md. (Assoc. M. July '49)

Albornoz-Plata, Eduardo, 14–16 Calle 55, Bogota, Colombia (Apr. '46)

Alhydro, Inc., A. C. Brumley, Pres., 316 Wyndhurst Ave., Baltimore 10, Md. (Assoc. M. Jan. '47)

Al Kaem, A. Mahdi Ali, 422 E. Washington St., Ann Arbor, Mich. (Jr. M. Jan. '50) *P*

Barlow, Willis D., 2 Sycamore Rd., Mount Vernon, N.Y. (Jan. '49)

Basenberg, Frank C., Polglaze & Basenberg, Engrs., 812 S. 27th St., Birmingham 5, Ala. (July '46) *MPR*

Beazley, Charles L., Deputy Provincial Secy., Dept. of Munic. Affairs, Province House, Halifax, N.S. (Jan. '48)

Beechwood, Christian T., III, San. Engr., State Dept. of Health, 11 Gilpin Rd., Willow Grove, Pa. (Jan. '50) *P*

Bigglestone, H. C., II, Resident Engr., Board of Fire Underwriters of Pacific, 905 Luhrs Tower, Phoenix, Ariz. (Oct. '49)

Bonsib, Roy S., 72 Walbrooke Rd., Scarsdale, N.Y. (Jan. '43) *MP*

Bretz, C. E., Cons. Hydr. Engr., 1916 N. Broadway, Oklahoma City 3, Okla. (Aug. '23) *MPR*

Briley, Harold D., Vice-Pres., Briley, Wild & Assocs., Box 3052, Daytona Beach, Fla. (Apr. '50) *PR*

Broach, Homer H., 160 Barksdale Dr., N.E., Atlanta, Ga. (Apr. '46) *MP*

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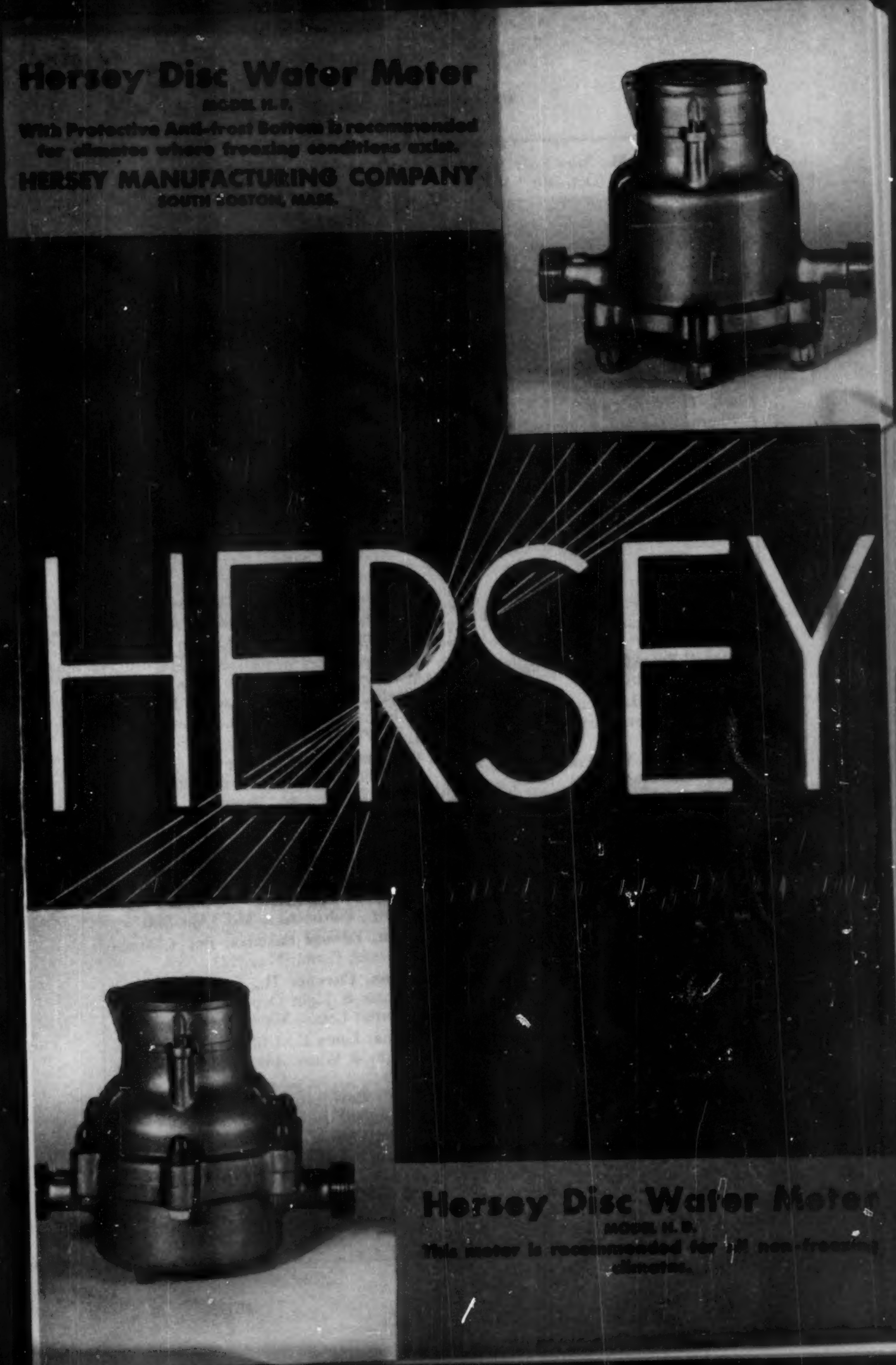

Hersey Disc Water Meter
MODEL H. F.
With Protective Anti-frost Bottom is recommended for climates where freezing conditions exist.
HERSEY MANUFACTURING COMPANY
SOUTH BOSTON, MASS.
HERSEY
Hersey Disc Water Meter
MODEL H. B.
This meter is recommended for all non-freezing climates.

(*Continued from page 38*)

Burnham, Lyle M., Sales Engr., 1375 Hall St., Salem, Ore. (Oct. '40) *MP*

Carmichael, George T., 1798 Quincy Court, Willow Run, Mich. (Oct. '49)

Carss, Harold W., Cons. Engr., 3 Black Block, Regina, Sask. (Jan. '47) *MPR*

Central Foundry Co., Charles A. Estey, Murray & Pacific Sts., Newark 5, N.J. (Assoc. M. June '03)

Chin, Tai, c/o Malcolm & Co. (China) Ltd., 33 Chungking Arcade, Kowloon, Hong Kong, China (Apr. '46)

Clark, Lloyd K., Clark & Groff, Cons. Engrs., 3245 S. Commercial St., Salem, Ore. (Jan. '39) *MPR*

Connors, Joseph J., 654 Beloit Ave., Berkeley 8, Calif. (Oct. '42)

Cowser, Kenneth E., San. Engr., East Central Region, State Dept. of Public Health, 625½ S. Wright St., Champaign, Ill. (Jr. M. Jan. '49) *PR*

Driggs, Richard J., West Coast Dist. Mgr., Dresser Mfg. Div., Box 209, South San Francisco, Calif. (July '49) *MR*

Drunagel, Franklin H., Mississippi City, Miss. (Jan. '49)

Dunmire, E. H., Cons. Engr., Water Softening Plant, Huron, S.D. (Apr. '40) *P*

Finch, Lewis S., Vice-Pres., Operations & Eng., Indianapolis Water Co., 113 Monument Circle, Indianapolis 6, Ind. (Oct. '33) *Fuller Award '49. MPR*

Fletcher, Alfred H., Director, Div. of Environmental San., State Dept. of Health, Trenton 7, N.J. (Jan. '36) *PR*

Frankhouser, Elmer V., Box 141, Danville, Pa. (Oct. '44) *P*

Galveston Water Works, Sewerage & Electricity Dept., R. W. Owens, Supt., Galveston, Tex. (Corp. M. Oct. '45) *MR*

Gerber, Winfred D., 625 Almeria Ave., Coral Gables 34, Fla. (Apr. '29) *Fuller Award '44. R*

Giffels & Vallet, Inc., B. Purden, Chief Mech. Engr., 1000 Marquette Bldg., Detroit 26, Mich. (Corp. M. Jan. '48) *M*

Gilmer, W. L., Polgalze & Basenberg, Engrs., 812 S. 27th St., Birmingham 5, Ala. (Apr. '46)

Gold, Donald D., 570 Twin Oak Dr., Apt. 1, Decatur, Ga. (Jan. '43)

Grant, Burton S., Chief Engr. of Water Works & Deputy Gen. Mgr., Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles 54, Calif. (Oct. '34)

Groff, Gilbert, Clark & Groff, Cons. Engrs., 3245 S. Commercial St., Salem, Ore. (July '46)

Harmon, Burt, 1175 E. Ocean Blvd, Long Beach 2, Calif. (Oct. '32)

Hendrix, Dave A., Dist. Mgr., California Water Service Co., Box 1351, Visalia, Calif. (Oct. '39)

Holzmacher, Henry G., Civil Engr., 344 Stewart Ave., Bethpage, N.Y. (Jan. '47)

Jacobson, Alvin R., 600 W. 168th St., New York, N.Y. (Jan. '42)

Johnson, Walter K., 2227—32nd Ave. S., Minneapolis 6, Minn. (Jr. M. Jan. '50)

Jones, James R., U.S. Geological Survey, Box 1384, Boise, Idaho (Apr. '49)

Kalinske, A. A., Director of Development, Infilco, Inc., 2750 S. 12th Ave., Tucson, Ariz. (Jan. '47)

Kilborn, R. K., Pres., Kilborn Eng. Co., Ltd., 36 Park Lawn Rd., Toronto 14, Ont. (July '46)

Krebs, Paul B., Polglaze & Basenberg, Engrs., 812 S. 27th St., Birmingham 5, Ala. (July '46)

LaMarre, Rene J., Supt. of Filtration, Casilla 1305, Guayaguil, Ecuador (Jan. '35) *Director '47–'50.*

MacLaren, James F., James F. MacLaren Assocs., Cons. Engrs., 705 Yonge St., Toronto 5, Ont. (Jan. '35)

MacMahon, J. D., Asst. to Tech. Director, Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md. (Apr. '45)

Minor, Edward Eastman, Box 4, Mount Carmel, Conn. (May '12)

Nelson, Clarence H., Supt. of Utilities, Water & Light Dept., 106 Holmes St., Detroit Lakes, Minn. (Jan. '48)

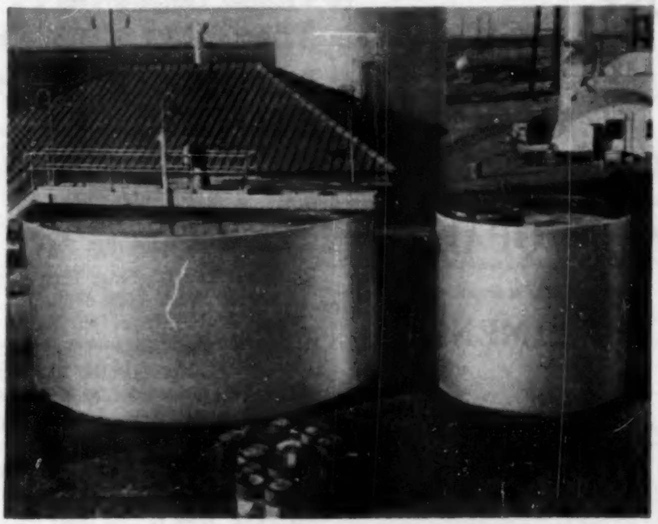
Nelson, Louis E., Utilities Supt., Munic. Light & Water, Litchfield, Minn. (Jan. '49)

Nixon, Ray, City Mgr., Trinidad, Colo. (Jan. '48)

Norris, Alfred O., Exec. Vice-Pres., Indianapolis Water Co., 113 Monument Circle, Indianapolis 6, Ind. (Jan. '50)

Opa-Locka, City of, H. C. Weber, Supt. of Waterworks, City Hall, Opa-Locka, Fla. (Corp. M. Oct. '48)

(*Continued on page 42*)



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(Continued from page 40)

Osborne, Herbert G., 259 Wilart Pl., Pomona, Calif. (July '48)

Pearce, Fletcher W., 709—9th St., Havre, Mont. (Jan. '42)

Peterson, Thoburn F., 417 N. Craig St., Pittsburgh 13, Pa. (Jan. '50)

Porter, Oscar S., Jr., 30 Sherman Ave., Pompton Plains, N.J. (Jan. '47)

Quick, Robert L., 41 N.E. 105th St., Miami 38, Fla. (Jan. '46)

Quinn, Joseph L., Jr., 133 S. 23rd St., Terre Haute, Ind. (Oct. '41)

Rinehart, Ray G., Sales Engr., James B. Clow & Sons, 1124 Moss Rd., South Bend 28, Ind. (Apr. '48)

Robinson, Joe Leslie, Dist. San. Engr., State Dept. of Health, 3806 Sherwood Dr., Fort Worth 7, Tex. (July '47)

Rutherford, Kyle W., 44 Kirkland St., Cambridge 38, Mass. (Oct. '49)

Senseman, Harold L., 15 Massachusetts Ave., Battle Creek, Mich. (May '27)

Simmons, John G., *see* West Palm Beach (Fla.) Water Co.

Smart, Roy Louis, Jr., Mathieson Chemical Corp., 1106 Liberty Life Bldg., 112 S. Tryon St., Charlotte 2, N.C. (Oct. '49)

Smith, Alphonsus P., Jr. Asst. Supt., Bureau of Water Supply, 2814 Riggs Ave., Baltimore 16, Md. (Oct. '49)

Soffe, Benjamin F., Box 408, Tucson, Ariz. (Apr. '44)

Stone, J. W. L., Fischer Well & Pump Co., 711 First American State Bank Bldg., Wausau, Wis. (Jan. '49)

Sunroc Refrigeration Co., John G. Wehrwein, Glen Riddle, Pa. (Assoc. M. Oct. '45)

Swab, Bernal H., 1101½ W. Main St., Oklahoma City 4, Okla. (Mar. '30)

Van Meter, L. R., Sales Repr., Neptune Meter Co., 1160 W. Eldorado St., Decatur, Ill. (Jan. '47)

Van Natta, Charles, Field Engr., Fairbanks, Morse & Co., 1803 Harvard Rd., Richmond 21, Va. (Apr. '48)

Weber, H. C., *see* Opa-Locka (Fla.)

West Palm Beach Water Co., John G. Simmons, Plant Supt., Box 1311, West Palm Beach, Fla. (Corp. M. Apr. '30)

Young, W. H., Supt. of Water Works, Box 44, Ormond, Fla. (July '40)

Condensation

Abstract Index

Page numbers refer to P&R section of Journal. Letters immediately preceding page numbers refer to month of issue, using following key: F—February; Mr—March; Ap—April; My—May; Je—June; Jl—July; Au—August; S—September; Oc—October; N—November; D—December (no abstracts in January). All subjects and page numbers in boldface type indicate first pages of topic sections or several abstracts on particular subject.

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Water Works
Manual

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Authors of Abstracted Articles

Page numbers refer to P&R section of Journal. Letters in italics immediately preceding page numbers refer to month of issue, using following key: F—February; Mr—March; Ap—April; My—May; Je—June; Jl—July; Au—August; S—September; Oc—October; N—November; D—December (no abstracts in January).

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Joseph W. Ivy Sr., western sales manager for National Cast Iron Pipe Co., died at his home in Kansas City on November 3, after a brief illness. He was 63 years old. A graduate of Georgia Institute of Technology, he had joined the NCIP organization in Kansas City in 1911, and in 1928 was appointed to the post he held until his death.

Edward Dunbar Rich, formerly director of the Bureau of Engineering for the Michigan Board of Health, died on September 29 at his home in Lansing, at the age of 82. From 1908, when he terminated a short but varied engineering career to come to Michigan as instructor in civil engineering at the University of Michigan, and also consultant to the State Board of Health, until his final retirement in 1946, he worked unceasingly to apply engineering methods to public health control. Perhaps the most significant testimonial to his efforts is the fact that the typhoid fever rate in Michigan in 1913, when he began his full-time connection with the Board of Health, was 17.54 per 100,000 population. At the close of his career it had been reduced to 0.11, with no case attributed to a public water supply for twelve years previous.

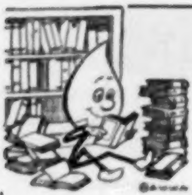
Information on binding the year's JOURNALS for permanent reference may be obtained from the A.W.W.A. office. Even simpler, an inquiry to the Library Binding Institute, 501 Fifth Ave., New York 17, will bring the names of certified binderies in any locality. Simply order Class A binding and furnish instructions on backbone lettering, cloth color, and whether to include or "strip" advertisements. Title and contents pages for the volume are included in this issue (following page 1204), and instructions to move them to the front of the bound volume should also be given. Before being sent to the bindery, the JOURNALS should be carefully checked for missing issues, torn or damaged pages or other defects.

A microfilm edition of the JOURNAL may be preferred by some institutions to conserve space. Further information may be obtained from University Microfilms, 313 North First St., Ann Arbor, Mich.

The new basic building code adopted by the Building Officials Conference of America, Inc., is now available in published form from George E. Strehan at BOCA headquarters, Room 1401, 51 E. 42nd St., New York 17, N.Y. The cloth-bound edition is priced at $6.50; the paper-bound, $5.00. The abridged building code, for smaller cities, is also available at $4.50 and $3.00 per copy.

Lloyd K. Clark, formerly manager of a sanitation research project for the Assn. of American Railroads, has joined the engineering firm of Clark and Groff.

(Continued on page 70)



The Reading Meter

Conservation Deluge

The year 1950 has brought to the American people a far better understanding of the importance of water resources and water supply than they ever before possessed. The New York City water shortage of late 1949 was in fact a "blessing through adversity" for the entire nation. Water works men in their less happy moments are prone to observe that their customers never consider the service behind the faucet—except when trouble comes.

But in 1950 the United Nations, the press, the radio, the magazines and the book publishers have vied with each other in dramatizing the emergency or in bringing better understanding of the nation's water problems.

Proceedings of the United Nations Scientific Conference on the Conservation and Utilization of Resources: Vol. 1, Plenary Meetings. *Dept. of Economic Affairs, United Nations, Lake Success, N.Y. (1950) $4.50. [Distributed by Columbia University Press, 2960 Broadway, New York 27, N.Y.]*

In August and September 1949, representatives of 48 countries assembled at Lake Success in a U.N. conference on conservation and utilization of resources. The discussions revolved about minerals, fuel and energy, waters, forests, lands, fish and wildlife. To the extent that present-day international limitations permit, the facts recorded in the account of the proceedings are as complete and authoritative as will be found in such compressed form at any point in the world. The volume is a "must" for public and university libraries.

Conservation of Natural Resources. *Guy-Harold Smith, ed. John Wiley & Sons, New York (1950) $6*

Conservation of Natural Resources is an account of America's forests, water, land, minerals, wildlife and fisheries. Written chapter by chapter by a group of specialists, the entire text is edited by Guy-Harold Smith of Ohio State University. The text contains enough statistical information to give it validity, and various sections have

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The Reading Meter

(Continued from page 58)

been competently written with enough objectivity to commend the material to the critical reader. The volume has value for the reading shelf of water works executives (or those who hope to be) as a source of general background information.

Water, Land and People. *Bernard Frank & Anthony Netboy. Alfred A. Knopf, New York (1950) $4*

Water, Land and People is the product of two writers whose recent years have been spent in Washington. Bernard Frank is a staff chief in the U.S. Forest Service and Anthony Netboy is a writer for the Economic Cooperation Administration. The book is dedicated to Edward N. Munns of the U.S. Forest Service—"a devoted public servant and master watershed planner." The book is a dramatic exposition of the interdependence of land and water resources, written in the fashion of the best propaganda—and valuable because of it. If

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The Reading Meter

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you have any doubt that the land resources and water resources of North America have been gaily squandered by our people, the reading of this book will resolve your hesitation. Those who relish a little engineering politics with their serious reading will be attracted by the chapter title, "Mirage of River-Basin Development—TVA."

Water and Man: A study in ecology. *Jonathan Forman & Ollie E. Fink, ed. Friends of the Land, Columbus, Ohio (1950) $5*

Water and Man is the assembled record of the 1939 meeting (the eighth) of the "Friends of the Land," an association of ardent conservationists. Chapter titles give a taste of the nature of the record: "Water—the Basic Stuff of Things," "Water is Our Most Precious Mineral," "Plan or Perish," "Lake Decatur is Dying," "Biography of a Watershed," "Use of Water on an Ohio Farm." Chapters are individually written, the last above mentioned by Louis Bromfield, author-farmer of Malabar Farm.

The reader who wants his water resources information couched in the manner of the religious revival will find *Water and Man* good for his soul. If he does not do a little preaching on his own after he reads it, he is a hardened sinner.

The Water Seekers. *Remi A. Nadeau. Doubleday & Co., Garden City, N.Y. (1950) $3*

Finally, "The Water Seekers" merits comment in this setting as the story of a great city's battle for water. Written much in manner of a novel, Nadeau tells how Los Angeles grew from a Spanish village to a great metropolitan center, by reaching out for more and more water to quench the thirst of its millions of people and their industries. For those who have heard something of Owens Valley, this book will reveal the whole story, and it will convince the reader that Mulholland and his associates, in their struggle to get water for the growing city, came face to face with some entrenched self-seeking people, who saw in the need of Los Angeles their chance to get rich.

The story of Herbert Hoover's part in the Colorado River Compact is told again and the book ends in the midst of the present Arizona-California issues before the Congress—just where the issues are today as Congress reconvenes.

Several of our A.W.W.A. members will be found in these pages —Mulholland, Van Norman, S. B. Robinson.

For a combination of hydrology, engineering and human relations (and sometimes civil war) *The Water Seekers* makes good reading.

Service Lines

Tapping prestressed concrete pipe is described in a four-page folder available from Price Brothers Co., 1932 E. Monument Ave., Box 825, Dayton 1, Ohio. Step-by-step photographs and drawings outline the procedure for making both small and large connections.

A "Soda Ash" manual offering technical data on properties, methods of analysis, production, use and handling is available from the Columbia Chemical Div., Pittsburgh Plate Glass Co., 5th Ave. at Bellefield, Pittsburgh 13, Pa. The 64-page illustrated handbook was prepared by the Pittsburgh organization and Southern Alkali Corp.

A corrosion-resistant coating said to add to the protective action of zinc the protection other ingredients afford to the zinc itself is described in an 8-page booklet entitled "Zincilate." Copies may be obtained from Industrial Metal Protectives, Inc., 401 Homestead Ave., Dayton 8, Ohio.

Dimetcote No. 2, an inorganic coating providing cathodic protection to metallic surfaces, is described and procedure for its application outlined in circulars available from Amercoat Corp., 4809 Firestone Blvd., South Gate, Calif.

A circular on AllCopper fittings intended for use with asbestos-cement pipe is offered by R. H. Baker & Co., 2070 E. Slauson Ave., Huntington Park, Calif.

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A "cushioned" surge relief valve is the subject of an eight-page bulletin (W-2) available from Golden-Anderson Valve Specialty Co., 207 Keenan Bldg., Pittsburgh 22, Pa. Cutaway drawings, tables of dimensions and operating and servicing information are provided.

Porous filtration media are covered in a 56-page engineering bulletin issued by the Refractories Div., Carborundum Co., Perth Amboy, N.J. The booklet is intended for basic reference and contains drawings, charts and illustrations which help present the necessary data. Specifications, information on uses and installation, and operating details are included.

Procedure and equipment for condenser tube rolling is covered in an eight-page booklet entitled "John Crane Tube Rolling Control." Copies may be obtained from Crane Packing Co., 1800 Cuyler Ave., Chicago 13, Ill.

"Research is Learning" is the title of a 32-page booklet setting forth the aims of research in engineering schools and giving typical case histories. Copies are being offered by the Secretary, Engineering College Research Council, Room 7-204, 77 Massachusetts Ave., Cambridge 39, Mass.

The use of horizontal motive power transmitted through right-angle gear drive to vertical pumps is the theme of an eight-page bulletin, "Peerless Gearturbo Pump Head," available from Peerless Pump Div., Food Machinery & Chemical Corp., 301 W. Ave. 26, Los Angeles 31, Calif. The folder is identified as B-140-1.

Pressure regulators, temperature regulators and other products of Spence Eng. Co., Walden, N.Y., are described in a four-page folder just issued.

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Steel shelves and drawers are the subject of an eight-page folder distributed by Equipto, Aurora, Ill. The company is featuring a new steel drawer separator with a tilt-back top for improved label visibility and reduction of scrapes and scratches incurred when fishing for small parts.

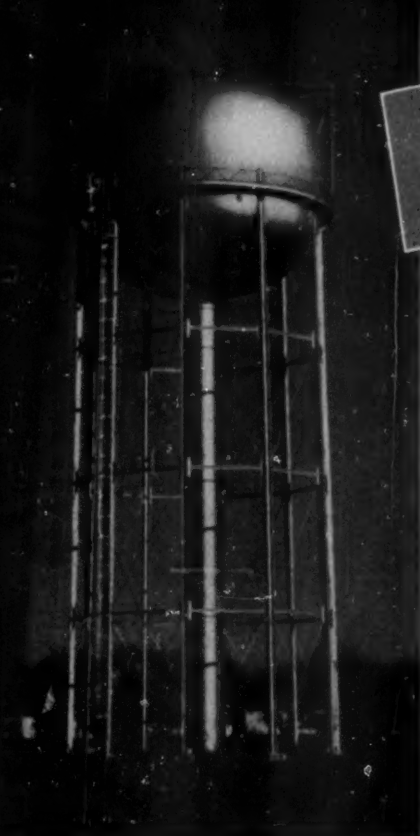
A bulletin, No. 1001, describing the Type GS pump is available from De Laval Steam Turbine Co., Trenton 2, N.J. The pump is designed for simplified service or exchange.

Strip-chart Dynamaster recording instruments are described in Bul. W1821 offered by the Bristol Co., Waterbury 20, Conn.

A folder on asbestos-bonded drainage structures may be obtained from Armco Drainage & Metal Products, Inc., Middletown, Ohio.

A compendium of laboratory supplies has been issued by Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa., and is available to laboratory personnel on request. The 986-page catalog, known as No. 450, is leather bound and lists over 25,000 items, cross-indexed by name and by function. Data on improved methods and aids for chemical analysis and testing are included.

"Clean Water Is Everybody's Business," says the U. S. Public Health Service, and in a 28-page booklet going under that title presents the facts of pollution and the need for its abatement in popular picture-story style. Single copies may be obtained from U.S.P.H.S., Federal Security Agency, Washington 25, D.C., which will also supply the needs of state pollution control authorities. Other requests are met by the Superintendent of Documents, Government Printing Office, Washington, who has copies for sale at 20¢ each.



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SEATTLE . . . 932 Lane Street
SANTA CLARA, CAL. . . 631 Alviso Road

(*Continued from page 56*)

An Inservice Training Course in Radiological Health is being offered by the School of Public Health of the University of Michigan at Ann Arbor on February 5–8, 1951. Among topics of water supply interest covered will be that of radioactive waste disposal.

James Girand has been appointed vice-president, operating, of the New York Water Service Corp. Previously assistant to the president, he had been superintendent of the Phoenix, Ariz., Water Dept.

Some remarks made by Mayor deLesseps S. Morrison of New Orleans on the occasion of the meeting of the Southwest Section of A.W.W.A. (a full report of which will be published in the January JOURNAL), departed so strikingly from the usual "Address of Welcome" pattern that they deserve reproduction in their entirety. It is hoped that those who serve public water supplies everywhere will find encouragement in the type of appreciation expressed by the Mayor:

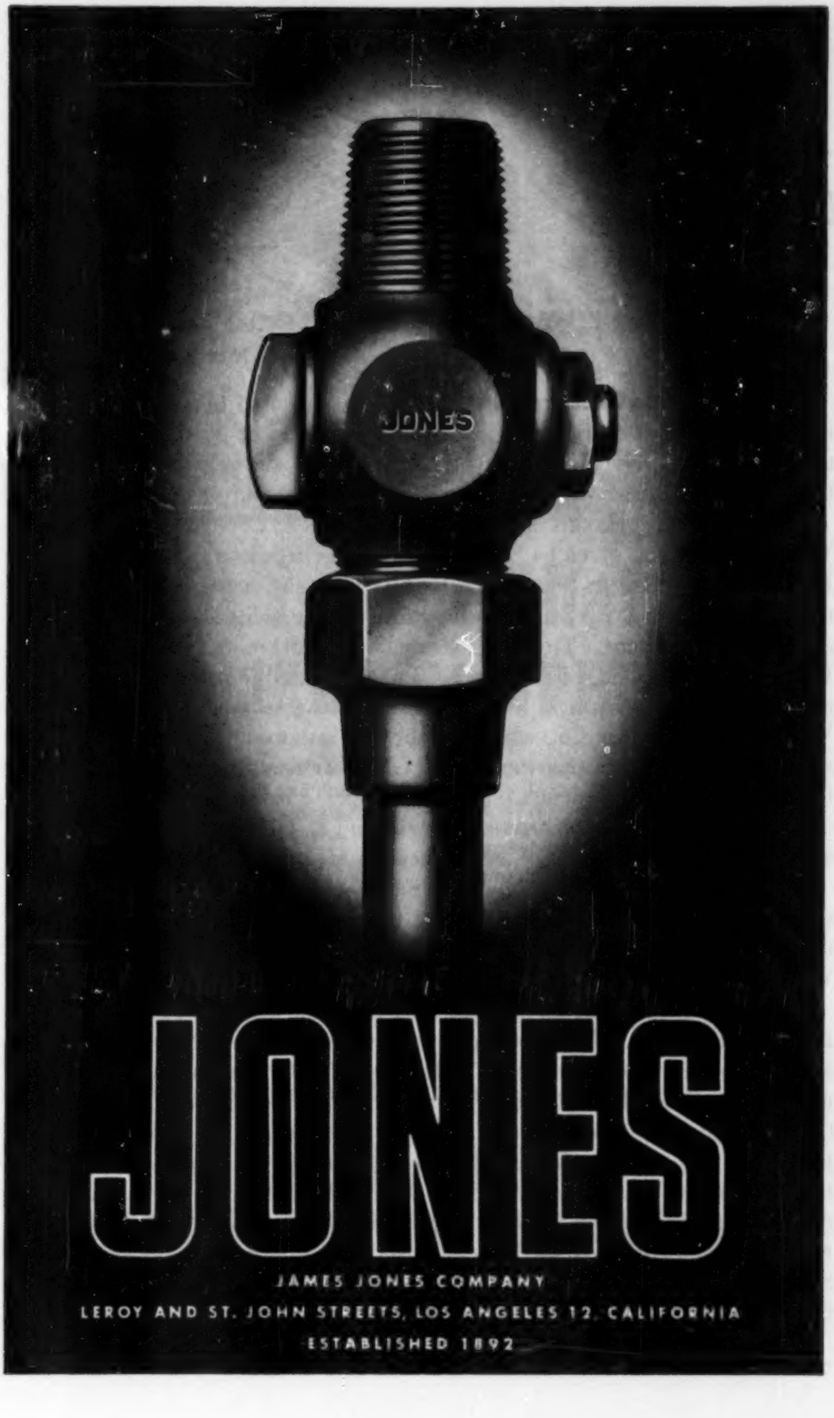
The people of New Orleans owe a debt of gratitude to the men who constitute the Sewerage and Water Board of New Orleans, a greater debt than they realize. Besides the four ex-officio members from the City Government —and let me say that I am proud to be ex-officio President of such a board— there are nine citizen members. Two of them are ex-officio members from the Board of Liquidation of the City Debt, which is itself a group of citizen members; the other seven, one from each Municipal District, are appointed for twelve-year terms, overlapping to ensure continuity.

These members serve without pay and their sacrifices in time and care and thought are heavy. They have been wise and faithful, many of them for long periods. Today, we thank Mr. Ellis for forty-one years of service, Mr. Casanas for thirty-five years, Mr. Perschall for twenty-five years.

Their prudence and wisdom and good judgment have brought rich benefit to the City in construction and operation of sewerage, drainage and water supply systems. Their prudent management and wise financing have made the most of the money provided. They have earned during these years the respect, honor and praise of the people they have served.

I am glad to remind you, our home people, and to tell you, our guests, of the splendid, unselfish work done by these men here with us today, and by the others before them whose names are enshrined in our records.

That is why it is such a pleasure for me to call public attention to their community service before this group. They are living symbols of the untiring service cities all over America are getting from able and public-spirited citizens. And it is indeed fitting to recognize before this Convention the value which New Orleans has received from this type of control of our vital sewerage, drainage and water system.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Section Meeting Reports

Pennsylvania Section: The Pennsylvania Section held its second annual meeting on October 18–20 at the Roosevelt Hotel, Pittsburgh. The total attendance was 210, including members and guests. Greetings were brought to the Association by Joseph A. Beck, Pittsburgh attorney.

The technical sessions opened with Chairman E. C. Goehring presiding. The first paper was given by S. A. Braley, senior fellow at Mellon Institute, Pittsburgh, on "Recent Research Into the Effect of Coal Mine Drainage on the Clean Stream Program" and this presentation elicited considerable discussion from the floor. This was followed by a panel on the subject "Where Do We Stand When Local Civic Groups Demand Fluoridation?" The panel leader was Martin E. Flentje, research engineer with the American Water Works Service Co., who very ably led a thorough discussion of this subject. Also contributing were K. A. Glenz, assistant division engineer of the Municipal Management Co. of Williamsport; Ralph Wortley, manager of the Uniontown Water Co., Uniontown; and L. D. Matter, assistant chief engineer of the Pennsylvania Department of Health, Harrisburg.

An excellent paper by N. P. Peifer, corrosion engineer, Pittsburgh, treated of "Laboratory Studies on the Galvanic Corrosion of Water Meters," with discussion by J. G. Carns, Jr., engineer of the American Water Works Service Co. Philadelphia.

The technical program on Thursday morning was presided over by J. D. Johnson of Erie. The first paper presented was that on "Action on Pollution Control in the Ohio River Valley" by John E. Kinney, sanitary engineer of the Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, substituting for executive director Edward J. Cleary, who was unable to attend. A panel discussion followed on "Corrosion Problems Following the Cleaning of Water Mains." This panel was ably led by D. E. Davis of the Chester Engineers. Others who discussed this panel with him were Robert J. Sweitzer, distribution engineer for the American Water Works Service Co., Philadelphia; D. E. McWilliams, manager of the Roaring Creek Water Co., Shamokin; W. H. Bottelsen, manager of the Oakmont

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Water Authority; Owen Rice, vice president of industrial sales of Calgon, Inc.; and Elbert J. Taylor, chief engineer of the Bureau of Water of Philadelphia. Kenneth C. Armstrong, superintendent of filtration of the Municipal Authority of Chester, spoke on "Water Laboratories—Layout and Operation" which was followed by an excellent discussion by R. R. Kountz, associate professor of sanitary engineering, Pennsylvania State College.

The Thursday afternoon session was presided over by Vice-Chairman T. H. Kain. The first paper on "Job Evaluation in the Water Works Industry" by Donald Farr, vice-president of the Methods Engineering Council, Pittsburgh, was very well received by the assemblage. Wendell R. LaDue, chief engineer and superintendent of the Bureau of Water and Sewerage of Akron, Ohio, and past-president of A.W.W.A. Association was the leader of a panel on "The Relative Value of Scheduled Maintenance vs. Maintenance by Necessity." Discussions on this panel were offered by James Kennon, managing engineer of the Pittsburgh Bureau of Water; J. D. Johnson, general superintendent of the Erie Bureau of Water; George W. Naylor, manager of the Vandergrift Water Co., Apollo; Thomas G. Braman, manager of the Citizens Water Co., Washington, Pa.; and James G. Criffiths, general manager of the Municipal Authority of the City of New Kensington. Walter C. Ringer Jr., sanitary engineer, and S. T. Campbell, plant chemist, of the Philadelphia Bureau of Water, presented a fine paper on "The Economies of Proportional Chemical Feeding."

The technical session Friday morning was presided over by L. D. Matter, section trustee, and was opened with a paper by Miss Marie A. Murphy, chief analyst, Pittsburgh Filtration Plant, on "A Practical Problem with Open Reservoirs." Harry J. Krum, city chemist of Allentown, very ably led a panel on "Experiences With the Use of Residual Chlorine Recorders" and was assisted in that discussion by John D. Beck, plant superintendent for the West View Water Authority, and Robert Widdop, technical representative of the Wallace & Tiernan Co., Newark, N.J. "Operation of the Walker-Clariflow Unit at New Kensington, Pa." was the subject of a paper by James P. Stowe, chief engineer of the Municipal Authority of New Kensington, with discussion by William A. Walton, sales engineer of the Dravo Corp., Pittsburgh.

The annual banquet of the convention was held Thursday evening and was well attended. A.W.W.A. Vice-President A. E. Berry brought greetings from the parent association and also from the Canadian Section. He gave an excellent short talk, including some suggestions for section activities, especially in honoring the past chairmen of the section. The audience at the banquet was delightfully entertained by the excellent musical renditions of the Rockwell Chorus under the able leadership of its director, Ted Yearling.

The Water and Sewage Works Manufacturers' Assn. provided get-together entertainment in the form of a Pow-Wow on Tuesday evening and

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social hours on Wednesday and Thursday afternoon. The 25 ladies at the convention were entertained at a luncheon and bridge party on Thursday afternoon and they were also well-distributed through the audience at the annual banquet.

L. S. Morgan
Secretary-Treasurer

Kentucky-Tennessee section: The annual meeting of the Kentucky-Tennessee Section, held in Memphis, Tenn., October 23–25 jointly with the Kentucky-Tennessee Industrial Wastes and Sewage Works Assn., was acclaimed a great success by those in attendance.

The two organizations met jointly on the first day and held separate sessions on the second day. The third day consisted of a joint business meeting and an inspection trip to the Memphis water plant. The registration totaled 222 persons, including 40 ladies but not including 70 employees of the Memphis Light, Gas, and Water Division who purchased dinner-dance tickets and attended the banquet held on Tuesday night.

The sessions opened with an address of welcome from Thomas H. Allen, president of the Memphis Light, Gas and Water Division, followed by a response by E. E. Jacobson, manager of the City Water Co., Lexington, Ky.

Dr. A. P. Black, A.W.W.A. Past-President, gave an excellent talk on civil defense, taking into consideration the possibility of atomic attack. Following his paper a committee consisting of C. M. McCord of Memphis, Henry M. Gerber of Louisville and Arthur L. Dow of Paris, Tenn., was appointed to draw up a resolution on atomic defense. The resolution as prepared was adopted by both organizations in joint session on October 25, 1950, with suggestions that municipal officials of each state and the governors of Kentucky and Tennessee be requested to make water and sewage works personnel an integral part of their civil defense organizations. A copy of the resolution is to be mailed to both governors and to the mayor of each city in the two states.

President A. H. Niles of the Federation of Sewage Works Associations discussed the organization's activities and included a report on its national meeting in Washington which had just been concluded. He particularly emphasized the increasing importance of industrial waste treatment and disposal in federation affairs and commented on the increased number of articles on industrial waste treatment and disposal recently printed in its journal.

The afternoon session included talks on stream pollution activities by Edward J. Cleary, executive director and chief engineer of the Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, and W. W. Towne, public health engineer and officer in charge of the Ohio and Tennessee

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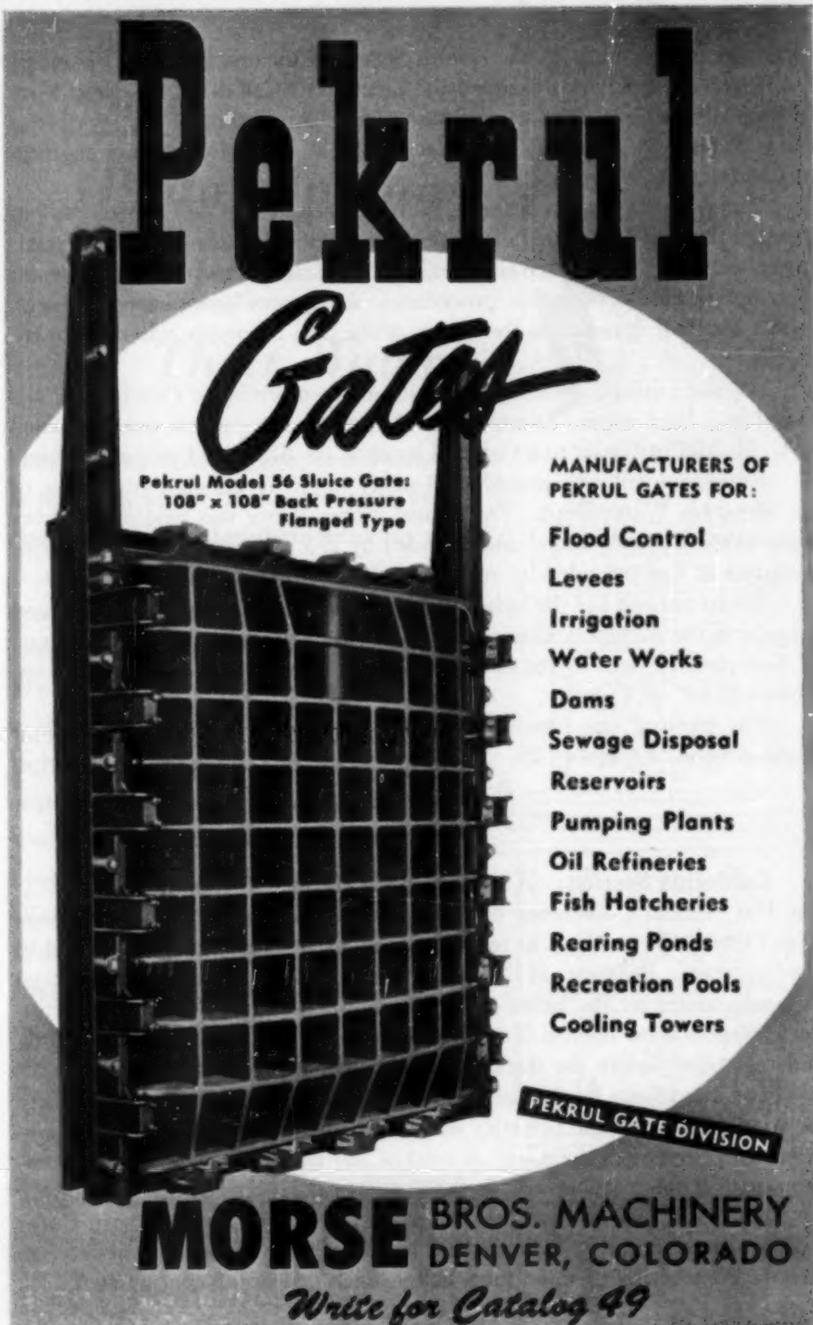
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Drainage Basins, U.S. Public Health Service, Cincinnati, Ohio. Financing municipal utilities was discussed by Lincoln E. Caffall of the New York firm of Wainwright, Ramsey and Lancaster. An outline of the services of the U.S. Geological Survey was presented by W. R. Eaton, district engineer at Chattanooga, Tenn.

The separate session of the A.W.W.A. section held on October 24, was devoted principally to panel discussions of specific operating problems relating to well supplies, surface supplies, the chemical treatment of water, water distribution practices, office procedures, and water pumping equipment, with a concluding paper on the design of the new Memphis water treatment works.

A joint business meeting was held on the morning of October 25, followed by a joint session at which the Memphis water system was explained by C. M. McCord prior to a visit and lunch at the Sheahan Pumping Station.

Entertainment was provided Monday night by talented employees of the Memphis Water Dept. The annual dinner-dance was held on Tuesday night at the Peabody Hotel and attended by 275 members and guests. Entertainment was provided by representatives of the Memphis Fire Dept.

Entertainment for the ladies included luncheon followed by bridge and canasta at the Memphis Country Club on Monday, and a sight-seeing tour of Memphis followed by tea at the Army and Navy club rooms at the King Cotton Hotel on Tuesday.

The meeting was concluded by the luncheon at the Memphis Water Plant at noon on October 25.

R. P. Farrell
Secretary-Treasurer

California Section: A new record attendance of 1267 was attained at the 31st Annual Conference of the California Section held in San Diego from October 24 to 27. The technical sessions and exhibits were located in the Conference Buildings at Balboa Park while the U.S. Grant Hotel served as headquarters for the ladies' entertainment and for the All Divisions dinner. Registration opened Tuesday afternoon and half of those attending had registered before the start of the technical sessions on Wednesday.

The attendance by the ladies at the special program provided for them likewise hit a new high, probably due to the memory of the excellent entertainment provided in the past. A total of 264 ladies registered for the conference. Of this number 132 attended the Wednesday tea at the beautiful La Jolla Beach and Tennis Club, 203 made the trip Thursday to visit Coronado and have lunch at Tijuana, and 153 spent Friday morning at the San Diego Zoo, meeting the men for a buffet lunch and organ concert at Balboa Park.

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The exhibits opened Tuesday afternoon with 45 organizations participating. The Conference Building was well suited for this purpose and interesting displays of water works equipment were provided for members and guests.

The annual golf tournament, under the able direction of Chairman Claude Faw of the Golf Committee, likewise hit a new peak of 60 players —two less than the number participating at the national conference. The tournament was held at the San Diego Municipal Golf Course on Wednesday morning. Very attractive prizes were awarded the winners at the Wednesday night dinner.

On Wednesday morning, before the start of the regular technical sessions, public utility district representatives held a meeting, as did the Water Pollution Committee.

The technical sessions were opened by Chairman Reinke Wednesday and the first paper, entitled "Features of the SanDiego Water System and Description of the New Alvarado Filtration Plant," was presented by Gerald E. Arnold, director of the San Diego Water Dept. This was followed by a "Review and Discussion of the California Section, A.W.W.A., Proposed Water Service Regulations" by William C. Welmon, secretary and chief accounting officer of the Southern California Water Co., Los Angeles. The entire afternoon was utilized for discussion of these proposed tentative regulations.

Wednesday evening the All Divisions winner was attended by 427 members and guests. As the principal speaker, President Weir stressed the necessity of water works officials taking stock of their operating equipment to see whether or not it is obsolete and should be replaced. He pointed out potential savings in the operation of new equipment and the necessity of keeping the entire system up to date.

After good entertainment by two local singers, the presentation of the Old Timers Citation was made to Samuel B. Morris and of the George A. Elliott Memorial Award to Roy E. Dodson Jr. in recognition of his leadership and faithful service in promoting and developing the certification and education of water works operators in California.

The Business Management, Plant Management and Operation, and the Purification Divisions held parallel sessions on Thursday. The program for the Business Management Division session, E. F. Dandridge presiding, began with "Do We Have Accounts or Records?" by Frank Twohy of the Los Angeles Dept. of Water & Power. The paper was discussed by Roy M. Sedgwick, (read in his absence by Howard W. Reed) and R. A. Campbell of the San Diego Water Dept.

"How California Cities Are Authorized to Issue Water Revenue Bonds" was explained by Stephen B. Robinson, Los Angeles attorney. "The Design of Water Rate Structures" was the contribution of R. L.

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Gresham, valuation engineer, Southern California Water Co., Los Angeles. W. J. Stephens of the East Bay Municipal Utility Dist., Oakland, spoke on "Engineered Supervision," and W. M. Harrison of the Coast Counties gas and Electric Co., Santa Cruz, discussed "In-Service Training."

At the Plant Management and Operation Division session, with Frank E. Alderman acting as chairman, "Photographing Water Wells" was explained by Claude Laval Jr., of the Fresno Camera Exchange, Fresno. "Water System Permits" were discussed by Henry J. Ongerth, senior sanitary engineer, for the Berkeley Dept. of Public Health.

A Panel Discussion on "Steel Tank Protection" was led by William C. Renshaw of Inglewood and included discussions of "Cold Paints" by H. A. Harris Jr., and P. M. Robinson, Jr. of the California Water Service Co., San Jose; "Coal Tar Enamel" by John W. Clay of the Alhambra Water Dept.; and "Cathodic Protection" by Harry J. Keeling of the Southern Counties Gas Co. of California, Los Angeles.

A "Mobile Phone Communications" panel included statements on "Three-Way Radio" by Nat J. Kendall of the San Jose Water Works, (read by H. A. Harris Jr.); and "Car Telephones" by M. J. Shelton of La Mesa, Lemon Grove & Spring Valley Irrigation Dist.

A paper on "Power Rate Selection and Off-Peak Use of Power Facilities" was presented by Percy P. Pine, of the San Diego Gas & Electric Co., San Diego. Robert C. Sargent of the American Pipe and Construction Co., Los Angeles, spoke on "Lining Large Pipes in Place."

The Purification Division session, with Roy E. Dodson Jr., as chairman, began by hearing James H. Keller of San Diego discuss "Control of Growths in San Diego Reservoirs." "Waste Water Reclamation Studies at Lodi" were presented by Ray V. Stone Jr., of the University of California, and "Diatomite Filtration" was the contribution of Joseph M. Sanchis of the Los Angeles Dept. of Water & Power.

Concluding the session was a round table discussion on "Operation of Purification Plants," offered by Martin F. Tillman, Antioch Water Works; Henry C. Myers, California Water & Telephone Co., National City; and J. N. Spaulding, Pacific Gas & Electric Co., San Francisco.

A business meeting was held at the end of each of the parallel sessions at which the Division officers for the new year were elected. Following the custom established a few years ago, Thursday night was left open to permit members and guests to do what they wished. A large number of the group went to Tijuana, Mexico, to see the dog races or the Jai Alai games and shop for souvenirs.

The General Session on Friday opened with a paper on "California's Water Pollution Control Program—Progress and Procedures" by Vinton W. Bacon of the State Water Pollution Control Board, Sacramento. This

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was followed by an excellent panel discussion on "Future Water Supply: Requirements and Availability." On the panel were C. C. Elder, Metropolitan Water Dist. of Southern California, Los Angeles, who spoke on "Domestic and Industrial Requirements"; Harry F. Blaney, senior irrigation engineer with the U.S. Dept. of Agriculture, Los Angeles, who spoke on "Agricultural Requirements"; and C. B. Meyer of the State Division of Water Resources, Sacramento, who spoke on "Availability of Water."

An outdoor buffet luncheon and organ concert was held for both ladies and men Friday noon at the Balboa Park Organ Pavilion. Over 500 members and guests enjoyed the lunch, the concert and the California sunshine.

In the afternoon a talk was given by Birchard M. Brundage, chief of health services, Atomic Energy Project, U.C.L.A., Westwood, on "The Implications of Radioactive Materials in the Water Works Field." He also showed the film "Operation Crossroads." This was followed by the "Water Works Disaster Committee Report" by John S. Longwell, chairman and consulting engineer, Piedmont. The discussion by committee members and from the floor was active and carried on late into the afternoon.

At the annual business meeting of the section, reports of the various committees were given and the new officers were elected. As the climax to two years' work by the Water Service Regulations Committee, the section adopted Tentative Water Service Regulations to act as a guide for water works engineers and executives in California.

The Conference closed with the annual Friday night banquet of the Water and Sewage Works Manufacturers' Assn. A total of 782 people attended and enjoyed good food, excellent entertainment, dancing and good fellowship.

WILLIAM W. AULTMAN
Secretary-Treasurer

Michigan Section: The twelfth annual meeting of the Michigan Section was held at the Detroit-Leland Hotel in Detroit, the motor city, on October 25–27. A record attendance of 214 registered helped to make the meeting a success and spoke well for the work of the various committees responsible for such a well-rounded program.

An innovation at this meeting was the split sessions on Thursday morning. The Well Session included "Operation and Maintenance of Wells" by Donald C. Ebgert, city manager of Birmingham, and Harold House of Lansing; and "Selection and Maintenance of Well Pumps" by George E. Hubbell, consulting engineer, and Harry Thomas of Detroit. At the Surface Supplies Session, Richard Hazen, consultant of New York, discussed the "Elements of Rapid Sand Filter Design." Filter plant operators John Dye of Lansing, Robert Hansen of Mt. Clemens and Howard Rafter

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told of their experiences with rapid sand filter maintenance. Both sessions closed with a "Question Box."

John Huss of the Michigan Municipal League discussed the "Relationship of Water Works to General City Administration." A highly interesting discussion resulted. A paper on "Uniform Accounting and Reporting" by Philip R. Potter of the Michigan Public Service Commission resulted in a resolution to appoint a committee to study the problem with special emphasis on the small water supply.

The Thursday afternoon session was opened with a narration of "Some Aspects of the Detroit Metropolitan Area Water Supply" by Laurence G. Lenhardt, general manager of the Board of Water Comissioners of the host city. Raymond J. Faust discussed "Civilian Defense as Related to Water Works." Robert L. McNamee, chairman of the Section's Committee on "Minimum Standards for Design, Construction and Maintenance of a Public Water Distribution System," made a very complete report. C. J. Velz of the University of Michigan gave a very stimulating analysis of "Statistical Evaluation of Bacterial Quality of Raw Water Supplies." The subject was well illustrated graphically with applications to actual water supplies.

The closing session heard George J. Hazey relate his experiences with automatic chlorine residual recording. C. V. Tossy of the Public Health Dentistry Section, Michigan Dept. of Health, presented a summary of "Evidence Supporting Water Fluoridation." The session was closed with a paper on records and testing by Raymond J. Faust.

The clubroom sponsored by the manufacturer's representatives proved again to be very successful and was handled with the usual professional skill.

At the annual banquet 79 people received the Edward Dunbar Rich Service Award for completing 25 years of meritorious and faithful service in providing and maintaining a safe and adequate water supply in Michigan. These awards were presented by John M. Hepler, director of the Division of Engineering, Michigan Dept. of Health. The toastmaster, R. J. Faust, presented the speakers of the evening. A. P. Black spoke briefly on the subject "The American Water Works Association in War and Peace," and concluded by formally announcing the appointment of Mr. Faust as Executive Assistant Secretary of A.W.W.A. A stirring round of applause paid tribute to the fine work and associations of Mr. Faust in the state of Michigan. The speaker of the evening, Hilton Ira Jones, Hizone Research Laboratories, spoke on "Peeps at Things to Come."

The well-planned and complete ladies' program resulted in a record attendance. Their program featured a visit to the Cranbrook Institute, the studio of television station WWJ, a theatre party and a lecture on the "Story of Linen." The ladies' program is proving to be an indispensable auxiliary to the regular meeting. A total of 64 ladies were in attendance.

T. L. Vander Velde
Secretary-Treasurer

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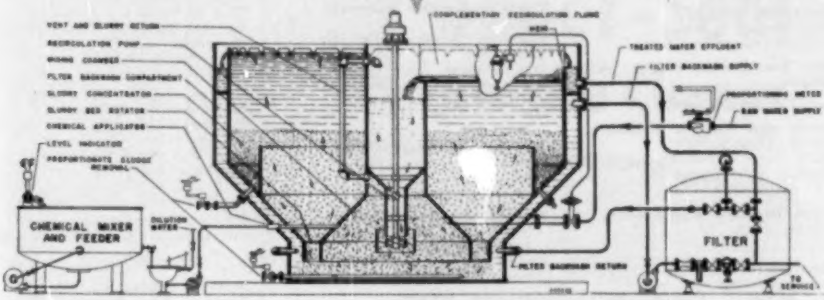

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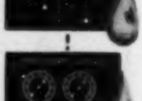

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